Commonwealth of Kentucky
Legislative Research Commission

Transportation Cabinet Management Review

December 2003

DYE MANAGEMENT GROUP, INC.

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January 12, 2004

Senator David L. Williams
Senate President
Co-Chair, Kentucky Legislative Research Commission

Representative Jody Richards
House Speaker
Co-Chair, Kentucky Legislative Research Commission

Mr. Bobby Sherman
Director, Kentucky Legislative Research Commission

Legislative Research Commission
Kentucky State Capitol
700 Capital Avenue
Frankfort, Kentucky 40601

Dear Senator Williams, Representative Richards, and Mr. Sherman:

Dye Management Group, Inc. is pleased to deliver this final report that documents the findings and recommendations from a Comprehensive Management Review of the Kentucky Transportation Cabinet conducted for the Kentucky General Assembly with oversight from the Kentucky Legislative Research Commission (LRC). This Comprehensive Review addresses some 30 analysis questions in over 12 major business areas and provides 55 individual recommendations.

This work was performed in a relatively short period of time and could not have been completed on this schedule with out the timely cooperation from the Kentucky Transportation Cabinet and the LRC staff. We would like to thank the LRC staff for their oversight. In addition, we would like to acknowledge the cooperation, timeliness, and openness with which the management and staff of the Kentucky Transportation Cabinet provided data, participated in interviews, provided insight, and responded to our questions about their agency.

With best regards,
DYE MANAGEMENT GROUP, INC.

David C. Rose, Ph.D.
Senior Vice-President

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Executive Summary

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I. Introduction and Overview

This executive summary presents the findings from a Comprehensive Management Review of the Kentucky Transportation Cabinet conducted for the Kentucky General Assembly with oversight from the Kentucky Legislative Research Commission (LRC).

A. Review Purpose

The Cabinet has a $1.8 billion annual budget for building, maintaining, and operating the majority of Kentucky's most important transportation infrastructure. The Cabinet plays a vital role in ensuring the economic and social well being of the Commonwealth and the quality of life of its citizens.

The General Assembly has had a long standing concern about the efficiency, effectiveness, and accountability with which the Cabinet exercises its responsibilities. This review evaluated current practices and identified changes for introducing more business-like management practices to ensure that highway dollars are used effectively.

The General Assembly intends that this management review will provide an agenda for action by identifying how the Cabinet's overall management structure, organization, and business practices can be strengthened. The recommendations herein provide the basis for this agenda for action that could be implemented to provide cost savings and improve the Cabinet's performance in planning, designing, building, maintaining, and operating the state's transportation system.

B. Review Focus

The LRC directed Dye Management Group, Inc. in consultation with LRC staff to perform this comprehensive review of the Cabinet in a relatively short period of time. The Cabinet is such a large complex organization that all business areas could not be addressed and evaluated to the same level of detail within the available time and budget. The review was focused on those areas of most significant concern and potential for improvement.

The review addresses the following:

- The Overall Managerial and Organizational Structure of the Cabinet.

- Project Selection and Prioritization.
- Review of Highway Financing Programs.
- Preconstruction and Project Management.
- Construction Procurement.
- Construction Change Order Management, Schedule and Cost Performance.
- Review of Accounting and Management Information Systems.
- Project Management Information Reporting Capabilities.
- DBE Compliance and Certification.
- Right of Way and Utilities.
- Construction Equipment and Light Vehicles Asset Management.
- Cabinet Buildings and Facilities Life Cycle Management.

C. Approach

To target the review, questions were posed and answered through data collection and analysis. The highest standards of quality and independent review were maintained. Dye Management Group, Inc. had no prior business relationships with the Cabinet and performed the analysis according to rigorous analytical guidelines. These guidelines provide fact-based analysis of Cabinet practices and their evaluation against industry best practice. The results of the analysis answered the questions and indicated areas for improvement.

D. Overall Findings and Recommendations

This *Comprehensive Management Review of the Kentucky Transportation Cabinet* addresses some 30 analysis questions over 12 major business areas and provides 55 individual recommendations. These are all listed in the following section.

The Cabinet should introduce more business-like management practices at the highest levels to provide accountability for the cost effective delivery, management, and operation of the state's transportation system. Within the Cabinet, many of the Division Directors have in place good practices and others are working on change initiatives that will bring more business-like management; however, often these managers are neither at the level nor have the authority to institute successfully the changes they seek.

The overall findings are that:

- There has been limited leadership attention to administrative management and the organizational health of the Cabinet.

- There are multiple layers of senior management and too many stand alone special purpose offices that do not align with the work flow.
- Senior management needs to introduce more business-like management practices.

Following are the major areas of opportunity identified:

- **Organizational and Management Change**

  Top management need to provide greater leadership, administrative direction, and attention to the management of the Cabinet through an organizational realignment that reduces the layers of management, consolidates stand-alone offices, limits one-on-one reporting relationships, and aligns management with the workflow.

  Top down leadership support and prioritization is required to ensure that the initiatives, energy, and desire for change that many line managers have is harnessed and that beneficial change is implemented.

- **Planning and Programming**

  The Six-Year Highway Plan is substantially over programmed. A new, financially constrained plan should be developed. It is neither desirable nor is there much opportunity to debt finance the funding shortfall.

  Most decision-making is at the project level. There is no guarantee that the individual decisions made on a project by project basis add up to make the most prudent investments for the state. Kentucky should establish an affordable plan for the future development, maintenance and operation of the highway system. In a situation in which needs greatly out strip financial resources, it is important that Kentucky establish a new, more financially constrained system level approach to planning and programming projects. This approach should be designed to ensure that individual project decisions fit together to build and maintain a transportation system that meets the state's economic and quality of life goals in the most cost-effective manner possible.

- **Construction Procurement**

  This review further documents a longstanding issue; namely, the relatively large number of construction contracts awarded that received one or two bids. Analysis indicates that there are significant cost savings to be realized by making the construction procurement environment more competitive. In the past two fiscal years, 26 percent of construction contracts, worth some $300 million, were let through single bid projects. Increasing competition should lower prices. Top management should give a high priority to addressing this issue.

- **Change Order Management**

  Overall, the Cabinet has effective change order management practices. However, the bulk of change orders have been concentrated on a relatively small number of projects. There are opportunities to improve change order management through understanding what is causing these high levels of change orders on a minority of projects.

- **Project Delivery Management**

  The Cabinet has taken steps to strengthen project management. Progress can be strengthened by making it a top management Cabinet-wide priority. A key element of accountability by the Cabinet to the General Assembly should be managing the delivery of a multi-year program of projects within the scope, schedule, and budget committed to in the highway plan.

II. The Overall Managerial and Organizational Structure of the Kentucky Transportation Cabinet

Question	Findings
1. How can the Transportation Cabinet's overall management practices be strengthened to improve performance?	• There has been limited leadership attention to administrative management and the organizational health of the Transportation Cabinet. • The Transportation Cabinet would benefit from the introduction of more business-like management practices. • The Transportation Cabinet has no clear public accountability mechanisms and management performance indicators. • The Blitz teams established by management identified a series of business improvement needs that the Transportation Cabinet should address.
2. Does the organizational structure provide barriers to the efficient management and performance of the Transportation Cabinet's business?	• There are a number of weaknesses with the current organizational structure for top management. • The value added by the positions associated with the different levels of management is not always evident. • The Cabinet tends to be very functional (segmented), although cash management has forced good cross-functional management. • Kentucky's highway program has a higher administrative burden than comparable states. • Engineering expenditures are comparable to other states.

Recommendations	
II-1:	Realign the organizational structure of top management to reduce the layers of senior management and provide accountability (page 19).

Recommendations	
II-2:	Institute an annual business planning process that sets strategic objectives and business improvement priorities (page 20).
II-3:	Establish separate lines of management responsibility for project delivery and the technical management of engineering disciplines (page 20).
II-4:	Establish a performance and work load based approach to budget and staff allocation across Districts (page 20).
II-5:	Provide proactive performance reporting to policymakers and the public (page 20).

III. Project Selection and Prioritization

Question	Findings
1. Where do projects come from? What is the process through which needs are identified and projects selected for inclusion in the Six-Year Highway Plan?	• Projects are identified through a bottom up participatory process that generates candidate projects for the Six-Year Highway Plan. • Project selection and prioritization process is not transparent. • Selection process is heavily driven by stakeholder, policy, and public considerations and priorities.
2. What are the strengths and improvement opportunities for the planning, programming, and project prioritization process?	• The planning process is project driven with little system-level consideration. • The current process is not effective in applying fiscal constraints. • The process for identifying and prioritizing maintenance and preservation projects is well-documented and technically driven. • The Kentucky Transportation Cabinet's long-range planning does not conform to industry best practices. • Needs analysis activities are fragmented across the Kentucky Transportation Cabinet and there is little system-level need assessment.

Recommendations	
III-1:	Establish vision and leadership for Kentucky's transportation system through a system-level planning process that sets policy direction regarding investment priorities that address all types of need in a new long-range plan (page 31).
III-2:	Establish a new programming and prioritization approach that links Six-Year Highway Plan categories to system-level needs assessment (page 32).
III-3:	Provide accountability through the Six-Year Highway Plan for implementing the long-range plan (recommended in III-1) and demonstrate what the plan buys in future plan documents (page 33).

IV. Review of Highway Financing Programs

Question	Findings
1. What opportunities are there to use debt instruments to address the shortfall? What is the unused borrowing capacity?	• Debt finance could only address a limited amount of the shortfall.
2. What is the nature of the current over programming of the Six-Year Highway Plan and how should the current shortfall be resolved?	• The Six-Year Highway Plan is over programmed by $1.94 billion of which $1.26 billion is programmed for state projects. • There are systemic pressures that create over programming. • Funding source and funding category drives the overall program structure as opposed to policy and planning objectives.
3. How effective are the measures that the Transportation Cabinet has taken to perform cash management in the current fiscally constrained environment?	• The Transportation Cabinet's models predict that cash balances will fall below $100 million in 2004 requiring a cash management plan. • The Transportation Cabinet has established a Cash Management system and instituted appropriate management controls. • There are opportunities to strengthen the cash management approach by: – Enhancing and refining project delivery management. – Establishing and managing to an acceptable level of risk. – Providing the Chief Financial Officer (or equivalent) with approval authority over Authorization Review Team decisions.

Recommendations	
IV-1:	Produce a new cash feasible and financially constrained Six-Year Highway Plan (page 53).
IV-2:	Use debt-finance selectively; borrowing is not a solution to over programming in the Six-Year Highway Plan (page 53).
IV-3:	Strengthen the Cash Management Plan by Setting Risk Based Cash Targets and establishing associated controls (page 53).
IV-4:	Broaden the role of the Authorization Review Team to a Cabinetwide Financial Planning Committee (page 53).

V. Preconstruction and Project Management

Question	Findings
1. How effective is the Kentucky Transportation Cabinet in delivering its Six-Year Highway Plans within scope, schedule, and budget?	• Design work has been completed on a timely schedule. • Design expenditures were some $15 million greater than design authorization.
2. How does the Transportation Cabinet compare to best practices for managing project delivery from project inception through bid letting?	• Implementing improvements to the Project Delivery Process requires greater leadership priority from executive management. • There are opportunities to strengthen project management capacity to ensure accountability for project delivery. • Project managers have limited information with which to manage the scope, schedule, budget, and overall delivery status of the projects for which they are responsible.

Recommendations	
V-1:	Strengthen project management as an executive priority (page 53).
V-2:	Designate a single "champion" for project management Cabinetwide as part of the organizational realignment recommended in Section II (page 53).
V-3:	Establish consistent project management procedures and codify in ongoing training and written reference materials (page 53).
V-4:	Establish standardized policies and practices for determining when and how preconstruction work is outsourced and managed (page 53).

VI. Construction Procurement

Question	Findings
1. Is the Commonwealth of Kentucky getting a competitive price through construction procurement?	• Forty-nine projects had one bid and this accounted for 26 percent of the total awarded amount of Six-Year Highway Plan projects in the past two fiscal years. • Single-bid projects are being let at a considerably higher cost than other projects. If single-bid projects had experienced the same bid patterns as those with two bids, Kentucky would have saved $53.8 million. • Overall there is limited competition on pavement projects of all types, whereas bridge projects are competitive. • Districts 2, 7, 9, and 12 together account for the majority of single bid contracts and experienced the least competition between July 2001 and June 2003. • Contract Award and Market Analysis – There are no written policies, procedures, or business rules for bid award analysis. – The Kentucky Transportation Cabinet does not perform a systematic market analysis of construction bids and contracts. – The contract award committee conducts bid award analysis.
2. Are incentive and disincentive provisions being used effectively? Are the level and types of incentives comparable to those of other states?	• The Kentucky Transportation Cabinet has begun to use incentive payments to good effect. • Managed effectively, incentives provide a valuable tool for reducing user costs and disruption to the traveling public. • Incentive payments are in line with industry practice.
3. Is the Commonwealth of Kentucky making use of innovative and non-traditional contracting approaches?	• The Transportation Cabinet has made limited use of innovative contracting. • The Transportation Cabinet is piloting design-build projects.

Recommendations	
VI-1:	Make increasing construction procurement competitiveness a top management priority for the Transportation Cabinet and report progress quarterly to the General Assembly (page 53).
VI-2:	Establish a cost estimating and markets analysis section to strengthen the development of engineer's estimates and perform bid analysis (page 53).
VI-3:	Use innovative contracting provisions that can reduce late or ensure on-time construction for projects with high roadway user costs (page 53).

VII. Construction Change Order Management, Schedule, and Cost Performance

Question	Findings
1. What is the magnitude and cause of change orders?	• Change orders amounted to $56.7 million or 2.7 percent by value of all construction projects completed in fiscal years 2002 and 2003. • Change orders are heavily concentrated on a relatively few projects. • Change orders are most prevalent on projects that are primarily pavement preservation. • The dollar value of change orders has been most heavily concentrated in Districts 5, 7, and 9. The numbers of change orders are fairly evenly distributed across the state. • There is no significant statistical relationship between the number of change orders and the engineer's estimate.
2. Does the Cabinet have effective management controls and procedures for change order management?	• It is entirely appropriate that change orders occur on construction projects provided that there are effective management and control procedures. • The Kentucky Transportation Cabinet does not maintain information documenting the cause of change orders and change order record keeping is generally weak. • The need exists for a stronger link between preconstruction and construction for change order and scope management. • Interviewees in the districts expressed concern that the Kentucky Transportation Cabinet faces risks due to the limited experience of some Resident Engineers and the shortages of construction inspectors.
3. Is construction delivered on schedule and within budget?	• Overall construction is performed on schedule. • The Transportation Cabinet has strengthened the management of construction schedules. • Construction projects are in aggregate delivered 2.6 percent under the authorized construction cost.
4. Does the Transportation Cabinet apply the appropriate level of resources to construction engineering?	• It appears that the Transportation Cabinet does not perform active program level resource management for construction engineering resources. • While interviewees indicated that positions are hard to fill, analysis indicates that in November 2003 there were only 10 unfilled positions out of 500.

Recommendations	
VII-1:	Establish a procedure for reporting change orders by cause (page 53).
VII-2:	Establish new management controls and procedures regarding change order review and approval to strengthen scope and quality management (page 53).
VII-3:	Revise the change order approval process to reduce approval time, and strengthen project financial management by ensuring that funds are encumbered in a timely fashion (page 53).
VII-4:	Evaluate practices used to establish construction schedules and identify opportunities to shorten them without reducing quality (page 53).
VII-5:	Establish, track, and report on construction project schedule and budget performance at major milestones (page 53).
VII-6:	Manage construction engineering work load and resource allocation across districts (page 53).

VIII. Review of Accounting and Management Information Systems

Question	Findings
1. Do the Cabinet's existing financial and other management systems properly capture and provide for ease of access to summary level data and reports desired by the General Assembly and other external entities?	• Financial Management – The Transportation Cabinet's financial management systems properly capture and provide for ease of access to summary level data and reports. – The Transportation Cabinet's financial management systems do not easily allow for ad hoc reporting or analysis by General Assembly or other non-Kentucky Transportation Cabinet staff. • Operations and Maintenance Management – The Kentucky Transportation Cabinet's operations and maintenance management systems properly capture and provide for ease of access to summary level data and reports desired by the General Assembly and other external entities.
2. Do the Cabinet's existing financial and other management systems properly capture and provide access to summary and/or detailed information required by Cabinet staff to effectively manage the day-to-day operations of the Cabinet?	• Financial Management – The Kentucky Transportation Cabinet's financial management systems, for the most part, properly capture and provide for access to summary and/or detailed information required by Cabinet staff to effectively manage the day-to-day operations of the Cabinet. – The most important gaps in management reporting include the inability to track detailed transactions at the project level, the requirements for dual record keeping on project authorizations between the Project Authorization System and MARS, and the difficulty for non-Fiscal or non-Budget staff to perform ad hoc reporting or analysis on the financial information. • Operations and Maintenance Management – Operations and maintenance management systems support management decision-making. – Work is underway to improve bridge management information.
3. How do the Cabinet's accounting and other information technology management systems compare with those of other transportation agencies nationally?	• General – The Kentucky Transportation Cabinet, like a number of state transportation agencies, has established Oracle as a common database architecture and is migrating a number of its old systems to market leading off-the-shelf software solutions. • Financial Management – The Kentucky Transportation Cabinet's financial

Question	Findings
	management systems have functionality and reporting capability comparable to those of most states. • Operations and Maintenance Management – The Maintenance and Equipment modules of the Operations Management System are competitive with other commercially available solutions in the marketplace. – The Highway Inventory System compares favorably to other inventory systems. – When fully implemented, the pavement management module of the Operations Management System should provide the Kentucky Transportation Cabinet with similar functionality to that found in pavement management systems used by other state transportation agencies. – Unlike most other state transportation agencies, the Kentucky Transportation Cabinet does not currently have a fully functional bridge management system. – The Safety Management Analysis tools developed for the Kentucky Transportation Cabinet by the University of Kentucky Transportation Center provide similar functionality for identification and analysis of safety projects as those being developed in safety management system applications by the FHWA, AASHTO, and other states.

Recommendations	
VIII-1:	Develop a data dictionary for key Kentucky Transportation Cabinet information from the Management Reporting Database and other management systems (page 53).
VIII-2:	Develop a detailed project charges report for use by project managers and other staff requiring access to detailed information (page 53).
VIII-3:	Continue adoption of off-the-shelf systems and standardization on the Oracle platform to the extent possible (page 53).
VIII-4:	Complete planned migration and upgrade projects designed to enhance pavement management and highway inventory functionality (page 53).
VIII-5:	Continue implementation of a fully functional bridge management system (page 53).

IX. Project Management Information Reporting Capabilities

Question	Findings
1. Do the Cabinet's existing project management and control systems provide project managers with the appropriate tools and information to effectively manage projects during both preconstruction and construction?	• For the preconstruction phase, the Six-Year Highway Plan application provides a reasonable level of project tracking. • During the construction phase of the Six-Year Highway Plan application there is limited project tracking capability. • Project managers do not have easy access to detailed project level financial information. • Project managers do not have access to a project scheduling tool. • Right of way specialists have considerable detailed tracking capability and project managers have summary information on right of way activities available to them. Project managers do not have any capability to access more detailed information to identify and monitor particular right of way purchases. • There is summary level utility status information available in the Six-Year Highway Plan application, but there is no capability for project managers to access more detail to identify and manage particular utility relocations.
2. Do the Cabinet's existing project management and control systems provide Transportation Cabinet senior management and program managers with appropriate and timely information about project status?	• Planning and Programming – The Six-Year Highway Plan application provides considerable information about projects programmed in the Six-Year Highway Plan application. • Project Status – The Six-Year Highway Plan application for preconstruction and the Contractor Pay Estimate System and Kentucky Construction Engineering Program application for construction can be used for general management control and some project specific reporting. – Senior managers have limited capability to identify or query projects based on certain performance criteria or project status to allow for identifying problems in particular projects.
3. Do the Transportation Cabinet's existing project management and control systems provide external parties (General Assembly, county or local officials, the general public, and others) with appropriate and timely information about project status?	• Quality of Project Information Available to the Public – The current Six-Year Highway Plan application and a great deal of procurement information are on the Kentucky Transportation Cabinet website. – Information about approved projects is available on the Kentucky Transportation Cabinet website.

Question	Findings
	• Project Information Provided to the General Assembly – The Kentucky Transportation Cabinet provides the General Assembly with a summary of Six-Year Highway Plan application and other project status in the LRC data set. This is not always received on time and is consequently becoming less useful to LRC staff. – In the past, some LRC staff had access to various management systems. With the exception of the Highway Inventory System, the Legislative Research Commission currently does not have access to any of the Cabinet's systems.
4. How do the Cabinet's project management and control systems and ease of reporting project status both internally and externally compare with those of other transportation agencies nationally?	• In many areas, Kentucky compares favorably to other agencies. • For project scheduling, project status monitoring, and utilities tracking, Kentucky can learn from other states.

Recommendations	
IX-1:	Incorporate key milestone dates for the construction phase into the status reporting function of the Six-Year Highway Plan application (page 53).
IX-2:	Develop a detailed project financial report for use by project managers to control more closely cost impacts to their projects (page 53).
IX-3:	Implement a project scheduling tool to improve management of critical events during the preconstruction phase (page 53).
IX-4:	Implement a standard set of project management reports and easy to use ad hoc query capabilities to provide snapshot status information on projects across the entire project life cycle and the ability to more easily query project information to allow identification and management of problem areas (page 53).
IX-5:	Provide LRC staff access to the Kentucky Transportation Cabinet's primary project management and control systems in lieu of the Kentucky Transportation Cabinet providing the current LRC dataset (page 53).
IX-6:	Continue implementation of the AASHTO Trns*port suite for letting, award, and construction management functionality (page 53).
IX-7:	Standardize information presented on the Kentucky Transportation Cabinet website about all projects regardless of project phase (page 53).
IX-8:	Create tighter linkage between the Six-Year Highway Plan application and Right of Way and Utilities application to provide project managers with enhanced capability to focus on and manage right of way and utility exceptions (page 53).
IX-9:	Complete the Utilities functionality planned for the Right of Way and Utilities application and link this detailed information with the Six-Year Highway Plan application for detailed reporting and analysis by project managers (page 53).
IX-10:	Consolidate the Gold File and Unscheduled Needs application to implement a single repository for all candidate projects (page 53).

X. Disadvantaged Business Enterprise (DBE) Compliance and Certification

Question	Findings
1. Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE met the certification requirements?	• The Office of Minority Affairs has a clearly defined program and set of business rules for certifying DBE firms and reaffirming eligibility. • Transportation Cabinet procedures reflect best practice. • The Transportation Cabinet has an appropriate level of staffing with four certification investigators and two certification advisors.
2. Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE do in fact perform work on construction projects in compliance with construction contract requirements?	• The Transportation Cabinet has strengthened overall compliance management practices to address past deficiencies in accordance with best management practices. • The Transportation Cabinet is applying compliance review best practices. • The Kentucky Transportation Cabinet DBE staff is not involved with routine contract compliance reviews. This function is the responsibility of the District EEO Officer, Resident Engineer, and Office of Contract Procurement. • The Transportation Cabinet conducts DBE compliance reviews on every project that has DBE participation. • Currently there are no statewide standards for the application of sanctions against prime contractors or DBE subcontractors.

Recommendations	
X-1:	Reconfigure the DBE certification panel to include the DBE staff and increase the frequency of meetings (page 53).
X-2:	Assign Certification Investigators to specific geographic areas while balancing workload (page 53).
X-3:	Establish statewide standards for the application of sanctions against contractors or DBE subcontractors not in compliance with DBE requirements (page 53).

XI. Right of Way and Utilities

Question	Findings
1. How can the right of way process be undertaken more quickly and right of way costs reduced?	• Right of way is the major cause of letting being rescheduled. • The Kentucky Transportation Cabinet's right of way tracking system (the Right of Way Status Report) is not effective. • The Kentucky Transportation Cabinet has challenges hiring and retaining qualified right of way staff. • Overall right of way is generally acquired within the authorized expenditure. • Inconsistency in the quality of right of way management among the districts was cited several times, at both Central Office and district levels. • The Kentucky Transportation Cabinet management and staff are ambivalent about the value added by consultants for right of way and utilities work.
2. How can the utility relocation process be undertaken more quickly and at less cost?	• Limited data on the location of utilities increases project costs. • The system that the Kentucky Transportation Cabinet uses to track the status of the utilities design and relocation process is rudimentary. • The actions of privately owned utilities, over which the Transportation Cabinet has no direct control, are causing project delays. • The Kentucky Transportation Cabinet's Procedures Manual for Utilities and Rail is out of date. • Central office decision-making may be causing delay for the districts.

Recommendations	
XI-1:	Update and maintain Right of Way and Utilities Policies and Procedures Manual and integrate into project delivery (page 53).
XI-2:	Develop an outsourcing strategy for right of way and utilities work (page 53).
XI-3:	Improve or replace the home-grown right of way and utilities tracking systems (page 53).
XI-4:	Use Subsurface Utility Engineering to better locate utilities (page 53).
XI-5:	Establish incentives to induce privately owned utilities to relocate their facilities in timely fashion (page 53).
XI-6:	Involve right of way earlier in the project delivery process (page 53).

XII. Construction Equipment and Light Vehicles Asset Management

Question	Findings
1. Does the Division of Equipment use best management practices in the planning, budgeting, and management of vehicles and equipment?	• The Division of Equipment selects and purchases equipment based on best value and life cycle cost considerations. • The Division of Equipment tracks life cycle cost information using the Equipment Management System. • The Division of Equipment has established standard policies and procedures for conducting preventive and routine maintenance. • The Division of Equipment has established a replacement schedule for heavy and medium equipment that reflects best management practice. • The Division of Equipment has established a rental rate structure for equipment that includes the full cost of ownership, operation, and disposal.
2. Does the Division of Fleet Management use best management practices in the planning, budgeting, and management of vehicles and equipment?	• The Division of Fleet Management identifies and purchases vehicles that are cost effective to the Commonwealth. • The Division of Fleet Management follows a replacement schedule set by the Kentucky Administrative Regulations; modifying the schedule will provide opportunities for cost savings. • The Division of Fleet Management has established a sound program for tracking and managing preventive and routine maintenance for light vehicles. • The Division of Fleet Management applies a rental rate structure that includes the full cost of ownership, including purchase, operation, and disposal. • The Division of Fleet Management tracks vehicle performance using two management information systems; problems with system architecture prevent accurate fleet analysis and reporting.

Recommendations	
XII-1:	Change Kentucky Administrative Regulations regarding equipment procurement authority to reduce equipment costs (page 53).
XII-2:	Review and, where appropriate, change the replacement criteria for light vehicles (page 53).
XII-3:	Evaluate the feasibility and business benefits from implementing revolving funds for operating both the Division of Equipment and the Division of Fleet Management (page 53).
XII-4:	Evaluate the businesses benefits of consolidating the management of all (non-exempt) light vehicles under the management of a single state agency (page 53).

XIII. Transportation Cabinet Buildings and Facilities

Question	Findings
1. Does the Division of Property and Supply Services use best management practices in the life cycle planning, budgeting, and management of buildings and facilities (fixed plant)?	• The Division of Property and Supply Services does not recognize or recover costs for maintaining buildings and properties for the Transportation Cabinet. • The Division of Property and Supply Services' current work order management system lacks the functional capability to easily and accurately track and report labor, tools, parts, or material expenditures. • The Division of Property and Supply Services has a preventive and routine maintenance program; however, few performance measures are tracked, impeding effective life cycle management of buildings. • The Division of Property and Supply Services does not have a long-term facilities management plan.

Recommendations	
XIII-1:	Establish a life cycle management approach for buildings and facilities (page 53).
XIII-2:	Evaluate the business benefits of consolidating the Transportation Cabinet's facility management responsibilities into the Division of Facilities Management in the Finance and Administration Cabinet (page 53).

I. Introduction

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The Kentucky General Assembly commissioned this *Comprehensive Management Review of the Kentucky Transportation Cabinet* with oversight from the Kentucky Legislative Research Commission (LRC). The review was carried out to achieve the following major objectives:

- To provide an independent, fact-based, comprehensive review of the Kentucky Transportation Cabinet.
- To identify areas of success and identify meaningful opportunities for improvement.
- To develop recommendations that can be implemented to yield tangible benefits and cost savings.

A. Approach

To meet the objectives of the review, a methodology that gets beyond perceptions through quantitative and qualitative analyses to develop fact-based recommendations was employed. The findings and recommendations contained in this report are based on information assembled through the following means:

- **Work with a Steering Committee.**

  A Steering Committee was established to provide overall guidance and direction for the review. It ensured that the General Assembly's most important issues related to the Cabinet were clearly defined and evaluated. The Steering Committee included:

  - John Cubine, Deputy Director for Budget Review.
  - Ginny Wilson, Deputy Director for Research and Finance.
  - Tim Firkins, General Counsel, Office of the Speaker of the House.
  - Bryan Sunderland, Legislative Policy Analyst, Senate Majority Leadership.
  - Kathy A. Jones, Committee Staff Administrator, House and Senate Transportation Committees.
  - L. Bart Hardin, Fiscal and Municipal Bond analyst, Office of Budget Review.

- **Clarification and definition of the questions to be answered by the review.**

  To ensure the review stayed focused and addressed the most important questions Dye Management Group, Inc. received input from the LRC steering committee to precisely define the questions that were researched and answered through the review.

- **Conducting interviews in Central Office and Four Districts.**

  Numerous interviews were conducted to identify issues, evaluate management controls, assess accountability structures, and identify current business procedures in the different areas of analysis.

  Interviews were conducted using structured interview guides to ensure consistency of the information gathered. The interviews were used to identify data and information sources, identify and determine issues that should be addressed by the review, and provide a control mechanism to ensure that data and information used in the analysis were reliable and relevant.

- **Review of existing documentation on procedures, rules, standards, and regulations.**

  The team collected and reviewed documented policies, procedures, and other guidance material available to Cabinet managers, staff, and contractors in the applicable business areas.

- **Collecting and analyzing data.**

  The Cabinet maintains a variety of data related to work flow and transactions in each of the areas analyzed. A series of indicators were developed to measure and evaluate performance. To the extent possible, given data source constraints, data were assembled to establish a quantitative information base.

- **Evaluating the Transportation Cabinet against best practice.**

  In each of the business areas evaluated, Cabinet practices were evaluated against industry best practice. Best practice assessment drew heavily upon Dye Management Group, Inc.'s prior detailed best practice surveys and analysis, conducted as part of other engagements, in many of the subject business areas. This was supplemented in a number of cases by targeted best practice and benchmarking with neighboring states.

B. Review Focus

The LRC directed Dye Management Group, Inc. and LRC staff to perform a comprehensive review of the Cabinet in a relatively short period of time. The Cabinet is a large, complex organization. All business areas could not be addressed nor evaluated to the same level of detail within the available time and budget. Therefore, to establish the overall focus for the work, it was decided that the review should address those areas of most significant concern and potential for improvement.

Within each of the review areas to target analysis, as well as determine where the Cabinet could make improvements to its processes and organization, a series of questions were posed and then answered through data collection and analysis. The results of the analysis provided answers to the questions and also indicated areas for improvement.

The review questions for each of the areas are as follows:

- **II – The Overall Managerial and Organizational Structure of the Cabinet**
  - **Question 1:** How can the Transportation Cabinet's overall management practices be strengthened to improve performance?
  - **Question 2:** Does the organizational structure provide barriers to the efficient management and performance of the Transportation Cabinet's business?
- **III – Project Selection and Prioritization**
  - **Question 1:** Where do projects come from? What is the process through which needs are identified and projects selected for inclusion in the Six-Year Highway Plan?
  - **Question 2:** What are the strengths and improvement opportunities for the planning, programming, and project prioritization process?
- **IV – Review of Highway Financing Programs**
  - **Question 1:** What opportunities are there to use debt instruments to address the shortfall? What is the unused borrowing capacity?
  - **Question 2:** What is the nature of the current over programming of the Six-Year Highway Plan and how should the current over programming be resolved?
  - **Question 3:** How effective are the measures that the Transportation Cabinet has taken to perform cash management in the current fiscally constrained environment?
- **V – Preconstruction and Project Management**
  - **Question 1:** How effective is the Transportation Cabinet in delivering its Six-Year Highway Plans within scope, schedule, and budget?
  - **Question 2:** How does the Transportation Cabinet compare to best practices for managing project delivery from project inception through bid letting?
- **VI – Construction Procurement**
  - **Question 1:** Is the Commonwealth of Kentucky getting a competitive price through construction procurement?
  - **Question 2:** Are incentive and disincentive provisions being used effectively? Are the level and types of incentives comparable to other states' practices?
  - **Question 3:** Is the Commonwealth of Kentucky making use of innovative and non-traditional contracting approaches?

- **VII – Construction Change Order Management, Schedule and Cost Performance**
  - **Question 1:** What is the magnitude and cause of change orders?
  - **Question 2:** Does the Transportation Cabinet have effective management controls and procedures for change order management?
  - **Question 3:** Is construction delivered on schedule and within budget?
  - **Question 4:** Does the Transportation Cabinet apply the appropriate level of resources to construction engineering?
- **VIII – Review of Accounting and Management Information Systems**
  - **Question 1:** Does the Transportation Cabinet's financial and other management systems properly capture and provide for ease of access to summary level data and reports desired by the General Assembly and other external entities?
  - **Question 2:** Does the Transportation Cabinet's existing financial and other management systems properly capture and provide access to summary and/or detailed information required by Cabinet staff to effectively manage the day-to-day operations of the Cabinet?
  - **Question 3:** How do the Transportation Cabinet's accounting and other information technology management systems compare with those of other transportation agencies nationally?
- **IX – Project Management Information Reporting Capabilities**
  - **Question 1:** Do the Transportation Cabinet's existing project management and control systems provide project managers with the appropriate tools and information to effectively manage projects during both preconstruction and construction?
  - **Question 2:** Do the Transportation Cabinet's existing project management and control systems provide Transportation Cabinet senior management and program managers with appropriate and timely information about project status?
  - **Question 3:** Do the Transportation Cabinet's existing project management and control systems provide external parties (General Assembly, county or local officials, the general public, and others) with appropriate and timely information about project status?
  - **Question 4:** How do the Transportation Cabinet's project management and control systems and ease of reporting project status both internally and externally compare with those of other transportation agencies nationally?

- **X – Disadvantaged Business Enterprise (DBE) Compliance and Certification**
  - **Question 1:** Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE met the certification requirements?
  - **Question 2:** Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE do in fact perform work on construction projects in compliance with construction contract requirements?
- **XI – Right of Way and Utilities**
  - **Question 1:** How can the right of way process be undertaken more quickly and right of way costs reduced?
  - **Question 2:** How can the utility relocation process be undertaken more quickly and at less cost?
- **XII – Construction Equipment and Light Vehicles Asset Management**
  - **Question 1:** Does the Division of Equipment use best management practices in the planning, budgeting, and management of vehicles and equipment?
  - **Question 2:** Does the Division of Fleet Management use best management practices in the planning, budgeting, and management of vehicles and equipment?
- **XIII – Management Review of the Kentucky Transportation Cabinet Buildings and Facilities**
  - **Question 1:** Does the Division of Property and Supply Services use best management practices in the life cycle planning, budgeting, and management of buildings and facilities (fixed plant)?

C. Review Components

The management review is divided into 13 sections. In addition to this introduction, there is a section on each of the major review areas:

- II – The Overall Managerial and Organizational Structure of the Cabinet
- III – Project Selection and Prioritization
- IV – Review of Highway Financing Programs
- V – Preconstruction and Project Management
- VI – Construction Procurement
- VII – Construction Change Order Management, Schedule and Cost Performance
- VIII – Review of Accounting and Management Information Systems

- IX – Project Management Information Reporting Capabilities
- X – Disadvantaged Business Enterprise (DBE) Compliance and Certification
- XI – Right of Way and Utilities
- XII – Construction Equipment and Light Vehicles Asset Management
- XIII – Management Review of the Kentucky Transportation Cabinet Buildings and Facilities

The review is presented in a question and answer format. Each of the 30 major review questions are addressed in turn.

II. The Overall Managerial and Organizational Structure of the Cabinet

■

This section provides a high-level review of the managerial and organizational structure of the Kentucky Transportation Cabinet. The section evaluates the overall legislative concern that the Cabinet has not been well-led in recent years, that the organizational structure is unwieldy, and that significant changes in the management and accountability structure are warranted to improve the efficiency and effectiveness with which the Cabinet performs its business.

The questions evaluated are:

- **Question 1:** How can the Transportation Cabinet's overall management practices be strengthened to improve performance?
- **Question 2:** Does the organizational structure provide barriers to the efficient management and performance of the Transportation Cabinet's business?

A. Question 1: How can the Transportation Cabinet's overall management practices be strengthened to improve performance?

The General Assembly is interested in identifying how the Cabinet's overall management structure and organization can be strengthened. The interest is in ensuring that there is a management that provides accountability for the Cabinet's performance in delivering products and providing services to the Commonwealth of Kentucky and that attends to the organizational health of the Cabinet. A key issue for policymakers is that, given the fiscally constrained environment, the Cabinet should adopt more business-like management practice such that existing highway dollars are used as effectively as possible. Further, the Cabinet needs to provide accountability and assurance of the proper expenditure of existing funds prior to any policymaker consideration of providing additional revenue sources.

1. Answer

The Cabinet would benefit from more attention to the internal management and administration of the Cabinet's business. This would require clarity of vision and an overall business plan that addresses the delivery of products and services, organizational health, and personnel management. A considerable number of senior management positions and a considerable amount of executives' time is spent on the "up management" of policymaker and stakeholder interests primarily around projects with less emphasis on the internal management of the Cabinet's business. By "up

management" we mean listening to and managing the different stakeholders and constituencies of interests around projects and the Cabinet's overall program.

While "up management" is important, the Cabinet is a $1.8 billion organization and requires the introduction of more business-like management practices at the highest levels to provide accountability for the cost effective delivery, management, and operation of the state's transportation system. Within the Cabinet, many of the Division Directors have in place good practices and others are working on change initiatives that will bring more business-like management; however, often these managers are neither at the level nor have the authority to institute successfully the changes they seek. There is a need for top management to provide greater leadership, administrative direction, and attention to the management of the Cabinet. Top down leadership support and prioritization is required to ensure that the initiatives, energy, and desire for change that many line managers have is harnessed and that beneficial change is implemented.

2. Analysis Strategy

The analysis approach involved:

- Conducting interviews with Cabinet managers in Frankfort and in a number of the districts.
- Assessment of organizational structure and head count.
- Review of strategic and tactical planning documents.

3. Findings

- **There has been limited leadership attention to administrative management and the organizational health of the Transportation Cabinet.**

  Cabinet leadership has not placed attention on the internal management of the Cabinet's almost 6,000 employees. There have been few initiatives to assess and improve the organizational health of the Cabinet and morale of these employees in the face of critical media attention.

  This lack of attention to the administrative management of the Cabinet is further evidenced by the Office of the Inspector General's findings that a "severe problem" exists due to the lack of standardized policy and procedures manuals and business practices, which result in inconsistency in business practices.[1]

  While maintaining many of the manuals is labor intensive, documented policies and procedures are extremely important in a large decentralized organization.

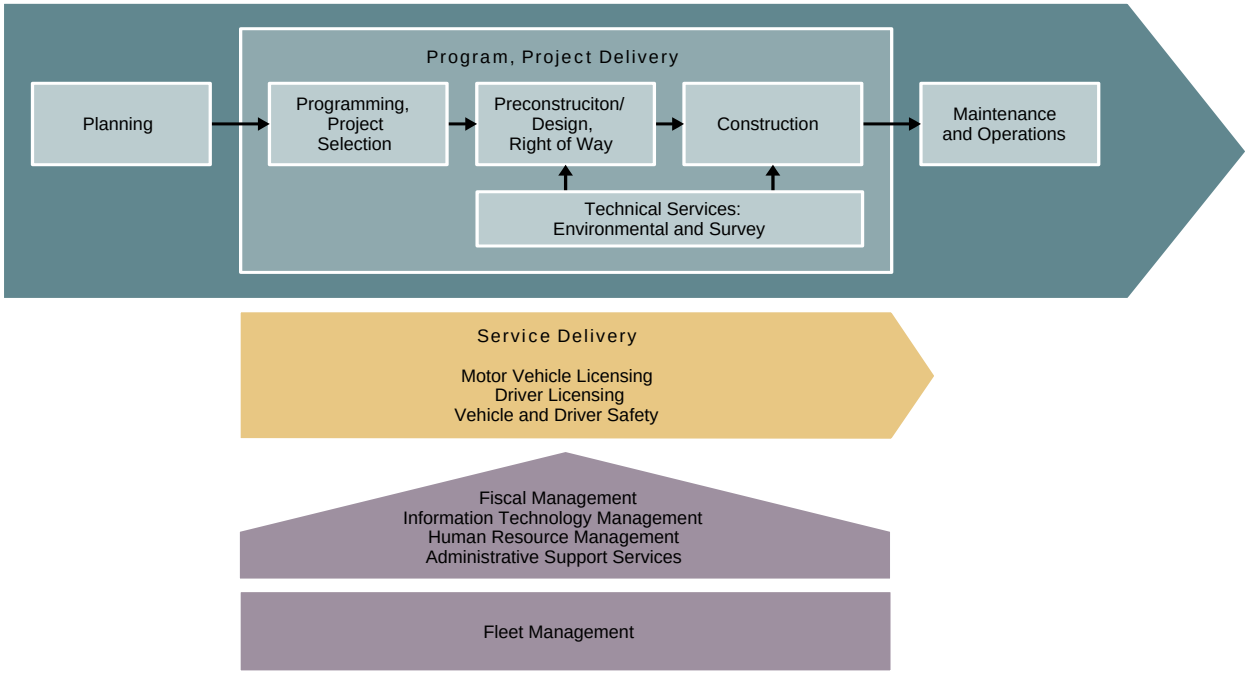
[1] Memorandum dated October 1, 2003 from Robert L. Russell, Inspector General to Secretary James C. Codell, III, Lack of Accurate and Current Policy.

Without this documentation there is no basis for ensuring that standardized approaches to business functions are followed across the districts. In addition, with the labor force changes that are being experienced, documented procedures provide guidance for the work to be performed by employees.

- **The Transportation Cabinet would benefit from the introduction of more business-like management practices.**

  The management of the Cabinet has been very functional (segmented) and focused on managing individual appropriation units. It would be more business-like to take what is called an enterprise approach and manage the Cabinet from the perspective of the work flow and the products and services that are provided. Exhibit II-1 provides a business-based view of the Cabinet. Under this view, the Cabinet is in the business of delivering transportation, primarily highway infrastructure, and then maintaining and operating that infrastructure. The Cabinet also has other "business lines," most notably the provision of motor vehicle and driver licensing services and other services related to vehicle and driver safety. Within the Cabinet there are a number of internal support services that provide the human resource, fiscal management, and technology services that enable products and services to be provided throughout the Commonwealth. Fleet management is a support service that the Cabinet provides to other state agencies. Recently, there has been an imperative for cash management which has forced good cross-functional management of this type within the Cabinet.

Exhibit II-1: Business-Based View of the Transportation Cabinet



With an enterprise perspective, management is focused on the role that different functions play in the delivery of products and services. Business improvement then targets improving the efficiency and effectiveness with which products and services are delivered.

The management of the Cabinet does not have a well-defined business planning process. The Cabinet has not operated using well-defined strategic plans or business plans. The Strategic Plan included in the Biennial Budget Request[2] lists a number of worthy initiatives but these do not provide a coherent plan for the strategic direction of the Cabinet or a direction for business planning.

In practice, it appears that there has been little departmentwide business planning to guide the Cabinet's operations. In a simple sense, the Cabinet would benefit from business planning that organizes and evaluates work performed against its role in delivering the Cabinet's products and services. There are good examples at the division or functional level. In the area of maintenance, the current budget request provides a clear tie through the maintenance rating program between service delivery performance and the budget. This analysis shows the impact on pavement and other conditions from different maintenance funding levels.

Best practice involves executive management conducting annual business planning through which strategic direction is set and business improvements defined and prioritized. This strategic direction is best defined as a series of measurable objectives, or performance measures, against which management holds itself accountable for delivering products and services to the Commonwealth of Kentucky. For example, a strategic direction would be establishing the objective for the on-time, on-budget delivery of projects and then tracking performance.

- **No clear public accountability mechanisms and management metrics.**

  One of the reasons that this review of the Cabinet was commissioned is the General Assembly's concern regarding the need for more accountability by the Cabinet for performance. Based on the review of management reporting practices, the study finds that the Cabinet has not established a proactive approach to providing policymakers with the type of information that they require to provide policy-level oversight regarding the efficiency and effectiveness of the Cabinet's business practices.

  It is important to note that Cabinet managers have been very responsive to requests from the General Assembly for information. What has been lacking is executive management defining the types of information that policymakers care most about and then reporting on a systematic basis how the Cabinet is performing in these areas. There has been some of this type of reporting and in Cabinet headquarters buildings there are posters charting performance measures.

[2] 2004-2006 Biennial Agency Budget Request, Kentucky Transportation Cabinet Volume I.

However, this is piecemeal and does not speak more broadly to General Assembly concerns. The "Path Report," a 2001 year-end report produced by the Cabinet, has similar deficiencies.

Best practice would involve the Cabinet establishing strategic performance objectives and then systematically providing accountability to policymakers and the public. A further feature of best practice is to communicate performance to policymakers and the public regarding those aspects of Cabinet performance that are most important to these stakeholders in a proactive manner.[3] This type of accountability can be provided through quarterly or annual reports and most importantly through the budget process.

- **The Blitz teams established by management identified a series of business improvement needs that the Transportation Cabinet should address.**

  Under the guidance of a number of office directors, teams of Cabinet employees were convened between 2000 and 2001. These teams undertook an analysis of key business areas and identified a series of business process improvements. The teams evaluated change order management, design process, right of way, and other areas. The work of these teams was thorough and a number of desirable improvement opportunities were identified. The implementation of the Blitz teams' work has been limited. In our opinion, this is because implementation of many of the recommendations cuts across functional areas, the Central Office, and the district and would require active executive support and endorsement. The managers directing the Blitz Team work did not have the authority to resolve all the issues and effectively implement the identified changes.

B. Question 2: Does the organizational structure provide barriers to the efficient management and performance of the Transportation Cabinet's business?

1. Answer

A realignment of the roles, responsibilities, and organization of top management at the Commissioner, Deputy Commissioner, State Highway Engineer, and Executive Director levels is required for an organizational structure that supports more business-like management and provides greater management accountability. Under the current organizational structure, there are multiple layers of senior management and many additional positions assisting senior managers in the Central Office.

[3] An example is the Washington State Department of Transportation, Measures, Markers, and Mileposts, Gray Notebook that is designed to provide accountability. Available: www.wsdot.wa.gov/accountability.

This situation is similar in the 12 districts, each of which mirrors the organizational structure in the Central Office. The districts together have management and administrative positions supporting the district engineers.

2. Analysis Strategy

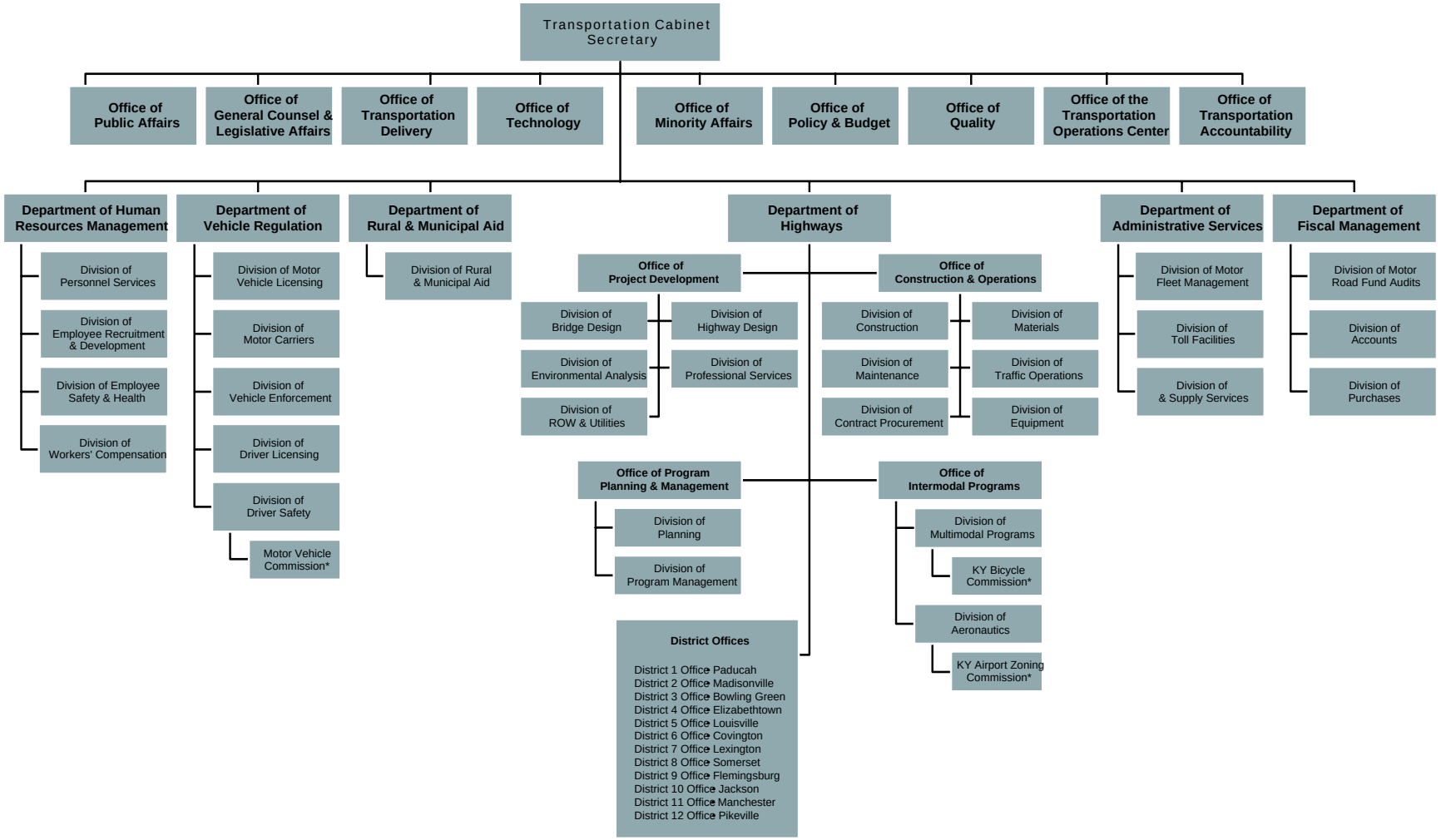
The analysis approach involved:

- Drawing on the results of the entire management review to provide findings on the overall performance and efficiency of the Cabinet.
- In each scope area, analysis of whether the management and organizational structure is a barrier to success.
- Evaluation of span of control, accountability, and other performance management procedures and practices.
- Evaluation of culture, practices, and priorities against state department of transportation best practices.
- Using comparative state-level data to compare Kentucky's administrative and engineering expenditures to other states.

3. Findings

The Cabinet is a complex organization with just under 5,800 employees and a current biennial budget request of approximately $3.6 billion. The current organizational structure for top management is depicted in the organizational chart, Exhibit II-2.

Exhibit II-2: Commonwealth of Kentucky Transportation Cabinet Organizational Chart



- **There are a number of weaknesses with the current organizational structure for top management.**

  There is a perception that the Cabinet is unwieldy. The Office of the Inspector General and the PRR[4] report came to this conclusion. This internal management review finds that the overall management structure for the Cabinet is indeed unwieldy. This does not stem from the Cabinet's having too many business functions but is due to its having an organizational structure with too many layers which are not always aligned with the Cabinet's work flow.

  The following weaknesses were identified:

  - There are too many levels of management. This can increase the time to make decisions and makes coordination more difficult.
  - There are too many stand alone special purpose offices.
  - There is too broad a span of control which is a barrier to communication and policy development. When the Transportation Cabinet Secretary and the Highway Commissioner is the same person, at least 19 management personnel report directly to this individual.
  - There are some business areas evaluated in this management review that face organizational barriers because the organizational structure does not always reflect the work flow.
  - There is the potential for duplication of responsibilities between the Highway Commissioner and Secretary.
  - The State Highway Engineer position has a broad span of control.
  - There is the tendency for the non-highway parts of the organization to get limited attention.

- **The value added by the positions associated with the different levels of management is not always evident.**

  Many of the management level positions depicted in the organization chart have associated deputy positions and assistant positions. Many of these positions have one-on-one reporting relationships and do not carry management responsibility.

  For example, in the Department of Highways, there is a Commissioner, a State Highway Engineer, three Assistant State Highway Engineers, and two principal assistants. Many interviewees questioned the value of these positions. As currently organized their value is not apparent because they all involve one-on-one reporting relationships to the State Highway Engineer, and have no supervisory responsibility.

[4] 2002 Program Review and Reform Committee Report.

Were they to have delegated supervisory responsibility, it would add another layer of management making communication and decision-making cumbersome. In the Departments of Administrative Services and Rural and Municipal Aid, there is a Commissioner, a Deputy Commissioner, and a principal assistant.

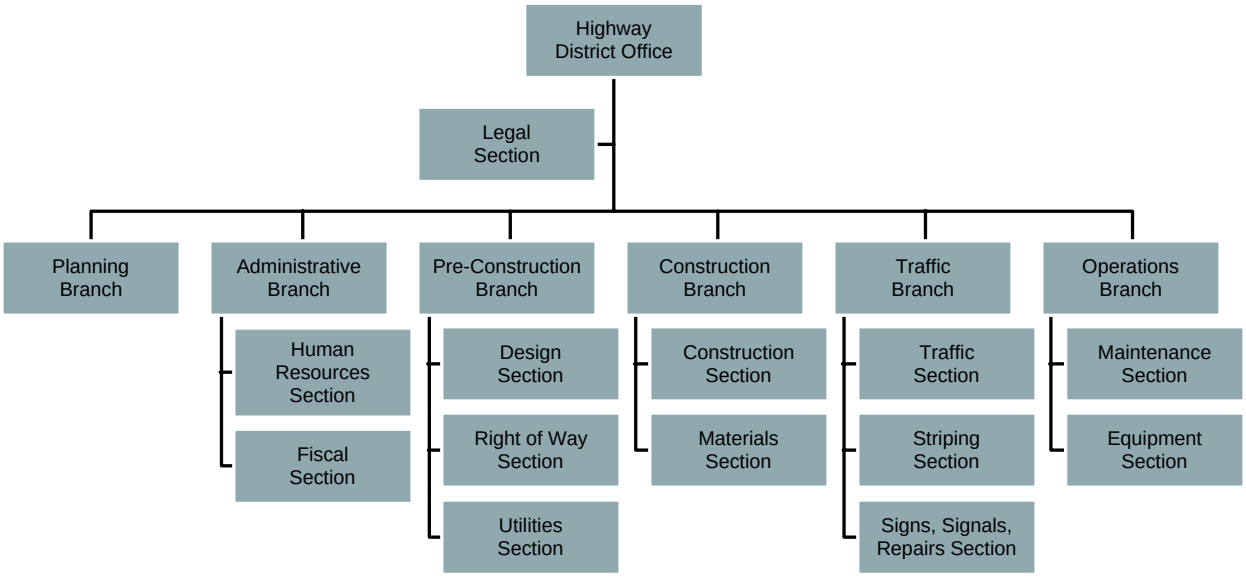
Interview results and other fact-finding indicate that reducing the layers of management and eliminating many of the one-on-one reporting relationships would yield a considerable savings.

- **The Transportation Cabinet tends to be very functional (segmented), although cash management has forced good cross-functional management.**

  It is difficult to align the management structure of the Cabinet with the work flow or the type of business-based view as presented in Exhibit II-1. Much of the management takes place at the appropriation unit level. Individual functions such as right of way or contract management are managed independently with only limited cross-functional management. The area of cash management is a notable exception because the Cabinet has addressed this independently, establishing an effective Cabinetwide management approach.

  A similar observation can be made regarding the districts. Each of the 12 districts has the organizational structure shown in Exhibit II-3.

Exhibit II-3: Department of Highways Organizational Structure



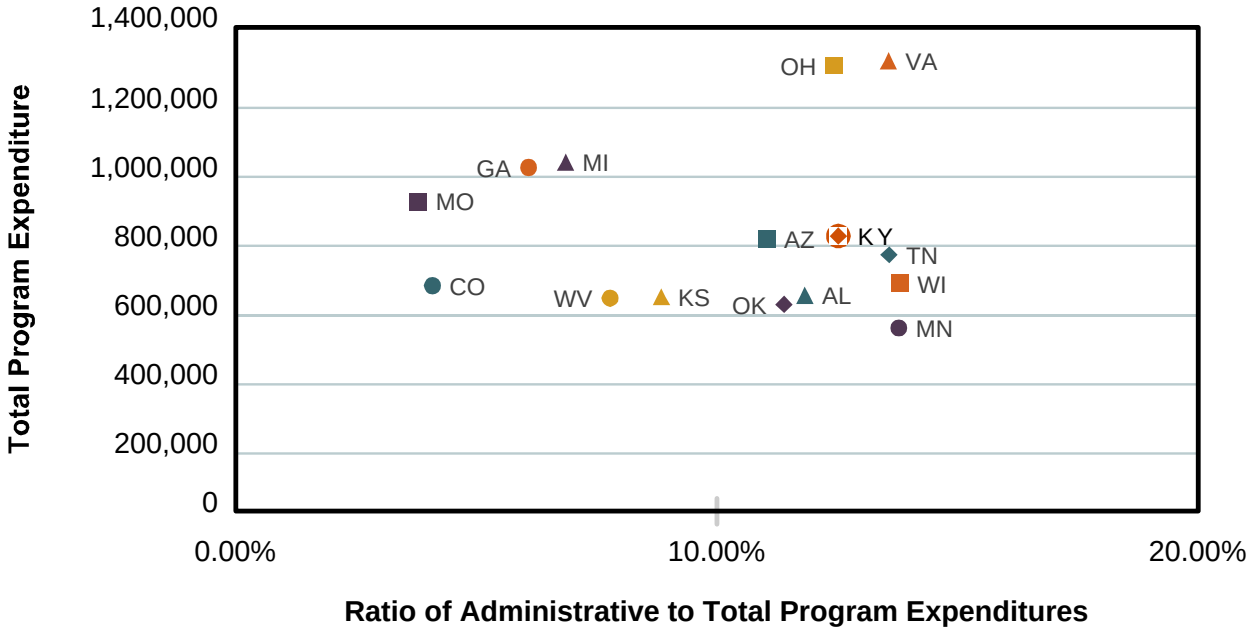
The functional approach to management is reflected in the districts. Across 12 districts this generates a considerable duplication of function; for example, there are some 380 district administrative positions and 36 district legal positions that report up through the 12 district engineers. The functional approach means that

technical services or other support services are not managed as a single function statewide creating duplication across districts and the potential for additional management overhead. It also makes it more difficult to standardize business practices across districts and increases the time required for decision-making.

- **Kentucky's highway program has a higher administrative burden than comparable states.**

  Data analyzed on state department of transportations' expenditures between 1997 and 2001 indicate that Kentucky has a relatively high level of administrative expenditures. Kentucky was compared to all states that had average annual capital outlays between $400 million and $1,200 million. The average ratio of administrative expenses to program delivery expenditures in the Cabinet was 11.75 percent compared to lows of 3.56 percent in Missouri and 5.75 percent in Georgia[5]. The results of this analysis are depicted in Exhibit II-4. The exhibit should be interpreted by considering that all states to the left of Kentucky have a lower administrative burden and those to the right a higher administrative burden.

Exhibit II-4: Administrative Expenditures as a Percentage of Program Expenditures



Source: FHWA Highway Finance Statistics, Office of Highway Policy Information. Available: http://www.fhwa.dot.gov/policy/ohpi/index.htm.

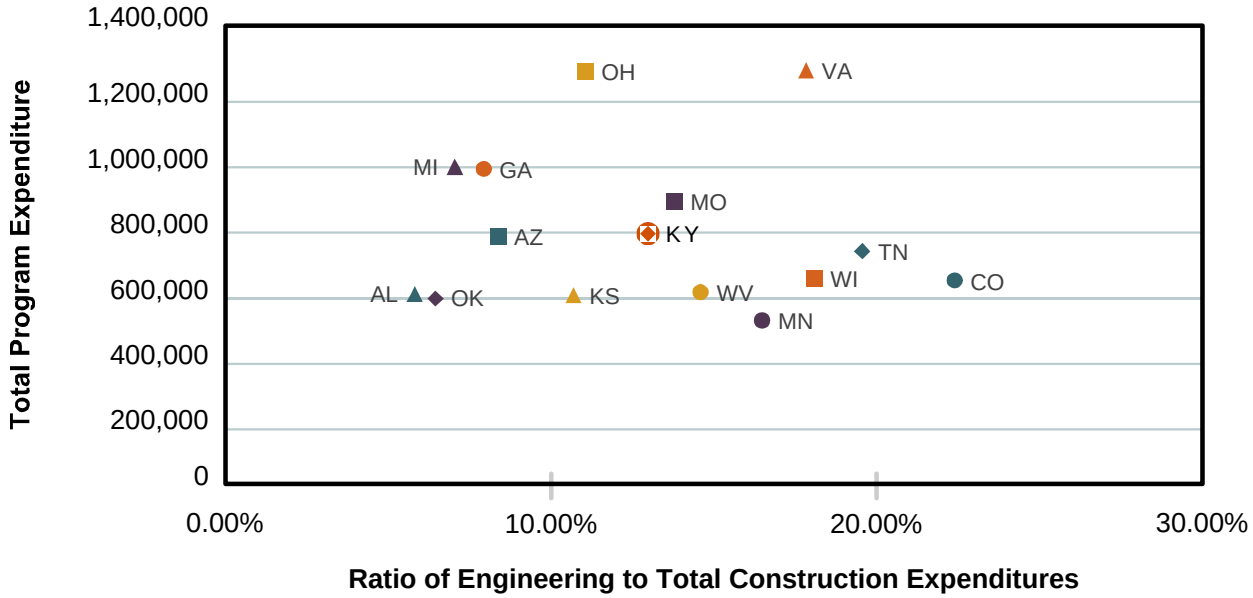
[5] Administrative expenses ratio is calculated as the ratio of 'general administration expense' as reported in FHWA 'SF4C' to the total capital outlay. This 'administrative expense ratio' is then compared against the total capital outlay ('acquisition of right of way' + 'preliminary and construction engineering cost' + 'highway construction and system preservation cost').

While there are some problems in comparing states using this data source due to different accounting and reporting practices, the data can be interpreted to indicate that Kentucky has higher administrative expenditures than comparable states. This tends to support the earlier findings regarding the number of management layers and stand-alone offices.

- **Engineering expenditures are comparable to other states.**

  Data analyzed on state department of transportations' expenditures between 1997 and 2001 indicate that Kentucky's expenditure on construction and preconstruction engineering as a proportion of construction expenditures is comparable to those state DOTs with a similar program size[6]. Exhibit II-5 compares Kentucky to other states. Although there are issues regarding the comparability of data due to different reporting practices, the exhibit can be interpreted as indicating that Kentucky's expenditure is in line with that of comparable states.

Exhibit II-5: Engineering Expenditures as a Percentage of Construction Expenditures



Data used for the charts is an average from the published statistics for the years 1997 – 2001 (2001 Statistics can be found at http://www.fhwa.dot.gov/ohim/hs01).

[6] Disbursements for state administered highways for each year is classified by function in the FHWA document 'SF4C.' We used the average 'preliminary engineering and construction cost' as a ratio of the sum of 'preliminary engineering and construction cost' and 'highway construction and system preservation cost.' This 'engineering expense ratio' is then compared against the total capital outlay + 'preliminary and construction engineering cost' + 'highway construction and system preservation cost').

C. Recommendations

1. Recommendation II-1: Realign the organizational structure of top management to reduce the layers of senior management and provide accountability.

The implementation of this recommendation involves reorganizing the overall management structure in the Cabinet to reduce the layers of management and assign clear lines of accountability. The reorganization can yield cost savings by reducing the overall management overhead, increase attention to the administrative management by flattening the management structure, and make decision-making more timely. Implementation can also reduce the number of positions by eliminating those that add limited value and/or reassigning the position to duties that add more value.

While this study is not the place to recommend a specific organizational structure, the following general guidance is recommended:

- The management structure and accountabilities should be more closely aligned to the Cabinet's work flow in delivering products and services as depicted in Exhibit II-1.
- The layers of management should be reduced such that there is a senior management position with responsibility and accountability for a major function that reports directly to The Secretary of Transportation or the Highway Commissioner.
- Budget, financial, and fiscal functions should not be fragmented and a chief financial officer position should be established with budget and fiscal management responsibilities recognizing the need for internal controls and segregation of duties.
- The number of special offices should be consolidated.
- The number and the opportunity for reducing deputy and special assistant type positions should be assessed. These positions are only warranted where they have direct line management responsibility as opposed to one-on-one reporting relationships.
- Staff resources should be redeployed to establish a dedicated project delivery coordinator or project manager responsible for one or more districts.

At the same time as these changes are instituted recommendations XII–4 (page 53) and XII–2 (page 53) should be implemented to determine whether the facilities management and the fleet management functions would be best transferred out of the Transportation Cabinet to the Finance Cabinet where similar functions are managed.

2. Recommendation II-2: Institute an annual business planning process that sets strategic objectives and business improvement priorities.

The recommended approach is that the Cabinet establish a straightforward business planning process and methodology through which executive and top management sets priorities for the entire organization. A time effective approach that results in a series of measurable objectives, priorities, and actionable improvement initiatives is recommended. What is most important is that there be follow-through with regard to implementation.

3. Recommendation II-3: Establish separate lines of management responsibility for project delivery and the technical management of engineering disciplines.

The administrative management of the Cabinet should have senior level positions that report to the Highway Commissioner and are directly responsible for the major business functions: planning and programming, project delivery, technical support services (which include the technical disciplines required to deliver projects such as roadway design, structural engineering, environmental and others), and maintenance and operations.

4. Recommendation II-4: Establish a performance and workload based approach to budget and staff allocation across districts.

The intent of this recommendation is to ensure that there is a management framework in place to ensure resources are distributed across districts based on workload. For example, the amount of engineering work can fluctuate from year to year in different districts or projects in the design phase could be delayed. Through this recommendation, the Cabinet would have a formal management approach and responsibility for redeploying labor if it is under-utilized in a particular district. This would not necessarily involve relocating a position but would make the employee available to perform engineering, right of way, or other work on projects in other districts.

5. Recommendation II-5: Provide proactive performance reporting to policymakers and the public.

Through this recommendation, the Cabinet would establish a performance report to provide accountability to policymakers and the public. The report should focus on the products and services that the Cabinet is delivering. The intent is that it provide a proactive approach to communicating with policymakers.

III. Project Selection and Prioritization

■

This section addresses the major issues raised regarding the overall planning, project selection, and prioritization process through which the Kentucky Transportation Cabinet evaluates the state's highway needs, establishes plans for addressing them, and then specifies and prioritizes highway construction projects.

The questions evaluated are:

- **Question 1:** Where do projects come from? What is the process through which needs are identified and projects selected for inclusion in the Six-Year Highway Plan?
- **Question 2:** What are the strengths and improvement opportunities for the planning, programming, and project prioritization process?

A. Background

1. Planning and Programming

a. What is planning?

Planning is the process through which the objectives are set for the future configuration or level of development of Kentucky's transportation system. Contemporary best practice is to establish a series of performance objectives for the current and planned future transportation system. Typically, transportation planning is performed for the statewide level, the metropolitan planning organization level, and for major corridors. Such planning establishes broad system-level needs for adding capacity and providing mobility, system preservation, safety, and other major categories of need.

Best practice involves the planning process establishing strategic investment priorities by allocating funds between broad policy objectives such as capacity, system preservation, safety, or economic development. Under best practice, the process is policy driven and supported by technical analysis that explains the level of performance implications of different investment decisions. For example, if a state funds pavement preservation at a level that minimizes life cycle costs, the analysis explains what funds are left over to address capacity projects. Such analysis enables policymakers to make broad system level trade-offs between different categories of need.

b. What is Programming?

Programming is the process by which projects are selected and funds committed to projects. The major work activity in this area is selecting projects for inclusion in the Six-Year Highway Plan and the biennial update to this plan. The selection of projects is constrained by the availability of funds for each type of project. Under best practice, most planning analysis is not conducted at the project level. The preferred approach is to identify and prioritize projects to implement the plan. This involves a strong linkage between planning and programming such that projects are selected to implement the plan. In this way, individual project selection decisions, when added together, develop the planned transportation system.

In general terms, best practice can be characterized as having a program structure that allocates resources between broad categories of need and then applies prioritization criteria within these categories of need to build the program. The overall program structure based upon the types of needs or planning objectives such as mobility, safety, or economic development is planning-driven.

c. What is project prioritization?

Prioritization approaches within categories reflect policy, stakeholder, and technical criteria. Under best practice, the categories are based on type or category of need and not funding categories. In this way, the "color of money" does not drive programming, and funds, regardless of source, are allocated to meet planning and programming priorities to the maximum extent possible within the constraints governing the use of funds.

Best practice involves a transparent and reproducible process. In this way, the decision-making criteria used to allocate resources between categories of projects and prioritize projects within categories are known. In general, best practice requires that objectives be defined for each category of project and then a procedure be established for ensuring that the project achieves these objectives. For example, many states have established a policy-driven objective that supports economic development and economic development projects. Best practice would involve establishing a reproducible procedure for determining economic benefit and prioritizing projects according to the anticipated benefit. In the areas of pavement management, bridge management, and benefit/cost analysis of capacity improvement, there are well established technical procedures for prioritizing projects.

2. The Kentucky Transportation Cabinet's Planning and Programming

The Cabinet has an established process by which needed construction projects are identified, specified in a number of planning documents, and programmed for construction.

The principal planning documents produced are:

- **The Six-Year Highway Plan.** This document is updated every biennium. It provides a six-year program of projects. The biennial element of the plan provides the basis for the construction program budget that is approved by the General Assembly. In this way, the General Assembly authorizes expenditure by phase for Six-Year Highway Plan projects. The Six-Year Highway Plan 2002 through 2008 currently contains projects with an estimated cost value of $6.92 billion. With an expected revenue of $4.98 billion over that period, the plan is substantially over-programmed.
- **Statewide Transportation Plan.** This is a 20-year plan that addresses federal statewide planning requirements. As such, the plan provides a 20-year list of projects that the Cabinet plans to develop. These would be future year projects for inclusion in the Six-Year Highway Plan. The most recent version was completed in 1999. The long-range highway element of the 1999 Statewide Transportation Plan contained $6.2 billion in projects. In the past, the long-range plan has been updated every four years.
- **Unconstrained Needs List.** This is a listing of most major capital project needs that have been identified by the Cabinet and transportation stakeholders. The list includes projects identified through technically-driven, policy-driven, and customer input processes. The list is not financially constrained. The current estimate of the dollar value of projects in this listing is $53.5 billion, which amounts to over 50-years worth of projects. The unconstrained needs list does not include projects for bridge replacement or pavement management.

B. Question 1: Where do projects come from? What is the process through which needs are identified and projects selected for inclusion in the Six-Year Highway Plan?

There is a strong perception that the process through which projects are identified and prioritized is highly politicized. The concern is that this has contributed to the current situation in which the Six-Year Highway Plan is substantially over-programmed and in which funds are not always allocated to projects that are in the best interests of Kentucky highway users.

1. Answer

Projects are identified though a number of policy-driven, technical, and advisory processes. The principal sources through which projects are identified are:

- Governor.
- Legislature.
- Public and local elected officials.

- The 15 area development districts.
- Cabinet headquarters analysis of capacity and safety needs.
- Cabinet pavement and bridge management systems.
- Cabinet district input.

These processes have generated a large backlog of needs which are unaffordable. The approach is “bottoms up” and very participatory with stakeholders across the state identifying potential projects.

Given the magnitude of project needs defined, the most important step for a project proponent is the way in which these needs are prioritized for inclusion in updates to the Six-Year Highway Plan. Our analysis indicates that the project selection process has been heavily driven by stakeholder, policy, and public considerations and priorities. This has resulted in a situation in which there is limited linkage between how individual projects are selected and how projects fit together to implement a longer range plan for a highway or network of highways.

2. Analysis Strategy

Our analysis approach included the following steps:

- Evaluation of documented procedures and planning documents.
- Interviews with employees to determine actual practice.
- Review of technically defined prioritization and project selection practices.
- Comparison with industry best practice drawing on Dye Management Group Inc.'s best practice knowledge.

3. Findings

- **Projects are identified through a bottom up participatory process that generates candidate projects for the Six-Year Highway Plan.**

  Project needs are identified through a number of mechanisms that are listed below:

  - **Governor and Legislature.** Policymakers at the state level identify candidate projects.
  - **Existing long-range plan projects.** The current long-range plan includes projects already identified through prior planning cycles that are reconsidered for the Six-Year Highway Plan.
  - **Kentucky Transportation Cabinet technical analysis.** The Division of Planning undertakes a technical assessment to identify project needs that

include a capacity and safety analysis. This assessment identifies a candidate set of technically warranted projects which are then categorized by the area development districts as high, medium, or low.

- **Local elected officials.** County judges, mayors, and other elected officials identify candidate projects, through the ADD process, to Cabinet districts, or directly to the Cabinet.
- **Area Development Districts.** There are 15 area development districts. Each district has a Transportation Planning Committee. These districts provide a regional mechanism for identifying project needs and prioritizing projects in their region according to low, medium, and high.

Pavement and bridge preservation projects are more technically driven.

The Division of Operations conducts technical analysis to evaluate project needs for system preservation, maintenance, and safety. There are four major programs. The major programs are in the areas of pavement, bridges, safety, and maintenance rating programs. The process for identifying needs and prioritizing projects differs somewhat for each.

- **Pavement.** The Division of Operations runs a pavement management system that identifies needs to rehabilitate or replace pavement throughout the state based on the pavement's physical condition. Condition is determined by crews from headquarters who continuously drive and monitor the condition of state-owned and maintained roads. They rely on both visual inspection for obvious problems, such as rutting and cracking, and on equipment with sensors that can assess the pavement's rideability or roughness.

  Each pavement segment is rated using a set of criteria that results in a point score. Based on these inspections and measurements, the Operations staff at headquarters develop lists of prioritized pavement projects for each district. These lists are sent to the districts for their input, so they have the opportunity to note areas the headquarters staff might have missed, or to reprioritize projects based on their own understanding of local needs.

  The districts return their input to headquarters, where Operations staff take the lists from all 12 districts and balance the needs and priorities across the state. The result of this process is a prioritized list that includes projects statewide. The list is then sent to the State Highway Engineer's Office, where final decisions regarding prioritization and funding are made.

  It is at this point that projects identified by neither Operations staff nor the districts sometimes find their way into the program, a situation

widely attributed to political influence on the part of state legislators. However, the Director of the Division of Operations believes that such projects account for 5 percent or less of the total.

Although this study did not evaluate the engineering science applied within Kentucky's pavement management system, the use of such systems is mature. The Cabinet has the capacity to use the system to identify strategies that minimize the life cycle cost of pavement preservation and, in so doing, substantially reduce infrastructure costs. The biggest issue impacting the ability to do this is the overall allocation of resources between pavement preservation and other needs.

- **Bridges.** The condition of the state's bridges is tracked in the Kentucky Bridge Information System, based on biannual inspections of virtually every structural element of every bridge in the state. Staff from the Division of Operations conduct these inspections. National standards govern determinations that a bridge is structurally deficient and therefore in need of repair or replacement. Bridges are assigned sufficiency ratings based on these national standards. The Kentucky Bridge Information System has some capability of running "what if" scenarios that can be used to find the optimal set of projects in terms of preserving the bridge infrastructure, ensuring safety, and making the best use of limited resources. The Cabinet is in the process of implementing a new bridge management system that will enhance such analytical capability. In addition to reliance on headquarters' inspections and the output of the Kentucky Bridge Information System, the Division of Operations also requests information from the districts on routine aspects of maintenance, such as deck replacements or rusty abutments.

  As is the case for the pavement program, Division of Operations staff then take the results of their analysis along with input from the districts and balance needs and resources across the state and present them as a prioritized list to the State Highway Engineer who determines their selection and priority for the Six-Year Highway Plan. Projects injected from outside the Division of Operations and the districts rarely, if ever, appear in the Bridge Program portion of the Six-Year Highway Plan.

- **Safety.** Division of Traffic Staff analyze data from a database owned by the state police called CRASH, which contains information on all reported accidents. These data are used to identify high accident locations (HALs). The number of accidents at given locations is combined with data regarding average daily traffic and factors such as adjacent land use in order to develop benefit-cost estimates used to identify and prioritize worthy projects. Again, the Division of Operations provides its initial lists to the districts, which then have an opportunity to point out any special circumstances or omissions.

- **Maintenance Rating Program.** In its effort to continuously improve the conditions of the roadway system, the Division of Operations has developed a program to identify areas of need outside the major categories of pavement, bridges, and safety. The Division deploys crews to drive randomly sampled state-owned roadway segments and rate them on 25 separate maintenance attributes, including aesthetics, brush, signing, drainage, and shoulders. Through this effort, the Division is able to understand the maintenance needs statewide and plan its programs and allocations accordingly. For instance, a recent finding is that the Cabinet needs to improve its drainage efforts.

– **Kentucky Transportation Cabinet Districts.** District maintenance personnel who travel the roadway daily have observational information on the condition of the roads and capital needs. They work with the Chief District Engineers to define proposed projects. Pavement management and bridge sufficiency monitoring carried out at the district level are input into this process. In some districts, planners and safety specialists analyze locations with high numbers of accidents and high projected need as another source of prospective projects.

– **Metropolitan Planning Organization (MPO) Transportation Improvement Programs.** MPO is the organization designated by the governor and local elected officials as the agency responsible, along with the state, for transportation planning in urbanized areas. The organization serves as a forum for cooperative decision-making by principal elected officials of local governments. MPO long-range plans and transportation improvement programs define projects for inclusion in the Six-Year Highway Plan.

– **Additional Public and stakeholder review and input.** Draft Six-Year Highway Plan updates are subject to public review and input.

– **The Unconstrained Needs List.** This list contains project needs identified in prior planning efforts but which are not included in the long-range or Six-Year Highway Plan documents. Projects can be moved from this list as part of the Six-Year Highway Plan cycle.

Through each cycle of plan updates, proposed projects exceed available resources. To prioritize projects, the Cabinet asks area development districts to prioritize all prospective projects into high, medium, and low. The Cabinet then subjects all the projects ranked to a technical analysis that considers safety and the capacity to further prioritize the projects. The technical analysis is then compared to the ADD and input received from the public involvement process to establish the project list. This prioritization is supplemented with project needs of importance to elected officials.

- **Project selection and prioritization process is not transparent.**

  The process through which project needs are reviewed and prioritized for inclusion in the Six-Year Highway Plan is not transparent to all parties in the process.

Cabinet staff interviewed in the districts are not sure how priorities are set and competing project needs reconciled. They reported that they are occasionally surprised by new projects in the Six-Year Highway Plan. Other employees believe that the process is heavily influenced by state and local elected officials to the detriment of efficient and effective resource allocation.

- **Selection process is heavily driven by stakeholder, policy, and public considerations and priorities.**

  Almost all the decision-making regarding investments takes place at the project level. Stakeholders, elected officials, and the public have a strong influence on the prioritization of projects. The technical consideration of project priorities is limited. In addition, there is little business-based analysis that answers such questions as "what does this project buy me?" in terms of cost savings or other benefits to highway users. Similarly, there is limited consideration of how a particular project advances overall strategic goals for the transportation network defined in the 20-Year Long-Range Plan or elsewhere.

C. Question 2: What are the strengths and improvement opportunities for the planning, programming, and project prioritization process?

There is a desire for the Cabinet to revisit the overall approach to planning and programming to ensure that best practices are followed.

1. Answer

The participatory nature of the planning process is its greatest strength; however, there are significant opportunities for improving the planning, programming, and project prioritization process. These opportunities are:

- Establishing an overall plan for the state that is more than a list of projects.
- Making the planning process more business-like by evaluating what Kentucky plans to buy and what benefit the Commonwealth achieves through highway investments.
- Providing a planning framework that establishes performance targets for the transportation system and directs resources to meet the targets.

These opportunities entail implementing a new approach through which long-range planning sets strategic direction for transportation investments. This can provide a framework for evaluating competing priorities in a fiscally constrained environment and ensuring that projects are prioritized and built that provide the greatest benefit to Kentucky taxpayers.

2. Findings

- **The planning process is project driven with little system-level consideration.**

  The Kentucky Transportation Cabinet's planning process develops lists of project needs at the short- and long-range planning levels. While every project need identified is important to the project's proponents, there is no mechanism for ensuring that individual projects are programmed and prioritized on a incremental basis to fit together to make the overall highway system as efficient and effective as it can be.

- **The current process is not effective in applying fiscal constraints to the development and management of Kentucky's transportation system.**

  The project-driven nature of the current process results in little distinction between needs and wants with respect to highway improvements. It appears that when project needs are identified in the Six-Year Highway Plan update process, they are not included in an unconstrained needs list if they are included in the update. There is no strong linkage between the projects proposed for inclusion in the Six-Year Highway Plan and the Long-Range Transportation Plan or other plans. There are few occasions on which proposed projects are not advanced to a project list due to financial constraints.

- **In a fiscally constrained environment and with the need for improved trust between the General Assembly and the Kentucky Transportation Cabinet, the type of planning that is required to be successful has changed.**

  As the highway system has developed and federal requirements have changed, Kentucky's growing population and economy have changed the type of transportation planning needed to make the Cabinet successful. This is compounded by the need to establish an improved relationship of trust between the Cabinet and the General Assembly to address Kentucky's longer-range transportation needs.

  For example:

  – Planning and programming needs to enable the Cabinet to be accountable for the performance of the transportation system.

  – Analytical approaches and tools used need to enable the Cabinet to use the available funds in the most cost-effective way to both preserve the existing infrastructure and meet travel demands.

  – Planning needs to address travel demand growth, the management of a developed state highway system, and partnerships with other agencies and organizations in developing solutions.

- **The process for identifying and prioritizing maintenance and preservation projects is well-documented and technically driven.**

  In general, the process for identifying and prioritizing maintenance and preservation projects is well-documented and technically driven and follows standards of best practice. Statewide standards are applied across the districts because the Division of Operations conducts the large majority of the analyses and then balances needs and resources across the districts based on technical need. At the same time, districts are given the opportunity to comment on the Division of Operations' assessments and initial prioritization. In our dealing with the districts, we came across no indication that any of the districts find this process to be misguided or unfair. Although some non-technically identified projects find their way into maintenance and preservation programs, these are generally in the area of pavement, and they are estimated to account for less than 5 percent of the total. As an example, the current process has been followed since about 1988 – before then, there was wide variability in pavement condition between districts – now, pavement condition is substantially similar across all districts.

- **Kentucky Transportation Cabinet's long-range planning does not conform to industry best practices.**

  Industry best practice involves an ongoing planning process that establishes policy-driven objectives for the current and future performance of the transportation system. Industry best practices include the following elements:

  – Establishing statewide planning as an ongoing process for setting an overall vision for the future of the transportation system and reaching agreement on the policies, priorities, and strategies for moving toward that vision.

  – Including a broad base of jurisdictional, modal, and other interests in the planning process.

  – Undertaking system-level needs analysis to enable the Transportation Cabinet and the Kentucky General Assembly to establish investment or overall funding priorities by allocating funds between broad categories of need such as preservation, safety, mobility, or economic development.

  – Providing a connection between policy, needs analysis, plans, and Six-Year Highway Plan projects and priorities such that the projects implement the policy and planning direction.

  – Linking the biennial budget process to the system-level policy and planning priorities.

- **Needs analysis activities are fragmented across the Kentucky Transportation Cabinet and there is little system-level need assessment.**

  The Cabinet has the capability to conduct system-level technically-driven needs analysis. Needs analysis responsibilities are distributed across the Divisions of

Planning, Operations, and Traffic check terminology. There are a number of tools available. The results of this needs analysis are used to develop plans and provide input into project selection. Interview results and review of work products indicate that there is no system and corridor level needs analysis that brings together all categories of need as part of the Cabinet's planning work.

The pavement management system and the bridge management system can be used to provide needs data. The highway performance monitoring system analytical process (HPMS AP) can be used to model system-level needs.

D. Recommendations

1. Recommendation III-1: Establish vision and leadership for Kentucky's transportation system through a system-level planning process that sets policy direction regarding investment priorities to address all types of need in a new long-range plan.

This recommendation involves implementing a new approach to long-range planning and system-level needs assessment that transitions the Cabinet to industry best practice. This is required for providing a policy-driven approach to address Kentucky's transportation needs in a fiscally constrained environment. Implementation should include:

- Providing direction for resource allocation between categories of need in the Six-Year Highway Plan and budget process.
- Identifying the extent and location of future growth and related transportation demands.
- Establishing system performance objectives that address mobility, highway preservation, safety, maintenance and operations, economic development, and other categories of need.
- Analyzing and reporting current and forecasting future system performance.
- Measuring needs as the difference between the performance objectives that are set for the system and current and future conditions on that system.
- Recommending policy and strategy alternatives to meet the system performance objectives. This should include providing direction for the allocation of resources between broad performance objectives or needs categories.
- Identifying actions, including both projects and other actions, that effectively implement the preferred strategies.
- Continuing to integrate broad-based stakeholder and public involvement into the planning process.

2. Recommendation III-2: Establish a new programming and prioritization approach that links Six-Year Highway Plan categories to system-level needs assessment.

This recommendation would implement major changes to the program structure and the approach through which project needs are prioritized for inclusion in the Six-Year Highway Plan. The intent of the recommended approach is to bring more business-like practices to the programming process and provide:

- Fiscal discipline.
- Accountability.
- Performance-based considerations.

At present, projects are selected to meet different funding categories. The intent of this recommendation is to structure the Six-Year Highway Plan around major categories of need, identified through the needs assessment (recommended in I-1). These categories would likely include capacity, system preservation, safety, maintenance, and operations. The overall program would then be divided between these categories and projects identified and selected. This approach would ensure that the program is balanced to reflect system-level needs.

The following best practices should be addressed when implementing this recommendation:

- Establish management controls for the Six-Year Highway Plan that ensure selected projects implement plan priorities.
- Establish project delivery management controls (addressed in Section V) that strengthen scope and budget management so that the Cabinet implements projects as planned.
- Establish financial management controls (addressed in Section IV) so that the Six-Year Highway Plan is fiscally constrained both in terms of authorization and cash.
- Mitigate the category of money driving projects by aligning funds, to the extent possible, to meet program and plan priorities.
- Ensure the process is transparent to customers and partners and reproducible.
- Build on existing project prioritization and ranking procedures for comparing projects within needs categories. These vary in their sophistication. Their purpose is to provide an analytical basis for prioritizing similar projects.
- Review the size of the contract maintenance program. Most pavement preservation needs are addressed through contract maintenance rather than in the Six-Year Highway Plan.

3. Recommendation III-3: Provide accountability through the Six-Year Highway Plan for implementing the long-range plan (recommended in III-1) and demonstrate what the plan buys in future plan documents.

The current documents provide little information that explains to the Cabinet's customers and partners what the outcome will be from the overall plan or the specific benefits to be derived from each project. This recommendation is to publish in subsequent Six-Year Highway Plan updates a description of the overall objectives for the Plan, the needs that are being met, and how the funded projects will improve the performance of the system. This should show in terms that are meaningful to the Cabinet's customers and business partners how the Six-Year Highway Plan will impact future system performance.

The Six-Year Highway Plan should include a statewide summary that shows how money is being spent by broad category such as capacity, roadway preservation, safety, traffic operations, and economic development and what will be the outcome from these expenditures.

IV. Review of Highway Financing Programs

■

This section evaluates the current use of debt in the highway construction program, solutions to over programming in the Six-Year Highway Plan, and the Cabinet's cash management practices. The focus for the analysis is determining the extent to which debt instruments can be used to address the current over programming in the Six-Year Highway Plan and more generally provide findings and recommendations regarding the most effective use of traditional and more innovative debt instruments to fund the delivery of Kentucky's highway program.

The questions evaluated are:

- **Question 1:** What opportunities are there to use debt instruments to address the shortfall? What is the unused borrowing capacity?
- **Question 2:** What is the nature of the current over programming of the Six-Year Highway Plan and how should the current shortfall be resolved?
- **Question 3:** How effective are the measures that the Cabinet has taken to perform cash management in the current fiscally constrained environment?

A. Question 1. What opportunities are there to use debt instruments to address the shortfall? What is the unused borrowing capacity?

There are always different perspectives regarding the desirability of using debt, and the extent to which debt should be used to finance a highway program. Regardless of conclusions about the desirability of using debt, a first consideration in evaluating the current level of over programming within the Six-Year Highway Plan is understanding what additional borrowing capacity there is, what debt instruments should be considered, and what would be the benefits and costs associated with the use of debt. This will provide information useful for evaluating the options to address the current Six-Year Highway Plan shortfall.

1. Answer

The current estimated shortfall in the Six-Year Highway Plan, provided by the Cabinet through Governor Patton to the Fletcher Transition Team, is $1.94 billion. Our analysis indicates the Commonwealth could not borrow an amount that would represent a significant portion of this shortfall without impinging upon at least one of the two current constraints on public debt: the maximum proportion of revenues that Kentucky's policymakers are willing to commit to debt service; and maintaining the Commonwealth's current credit ratings. Further, this $1.94 billion represents the difference between expected revenues and planned Six-Year Highway Plan obligations

(not expenses) for the state-funded (SP) and federally funded elements of the Six-Year Highway Plan from 2004 through 2008. Therefore, actual expenditures to deliver these planned projects could be more than the planned obligations.

Issuing debt to cover a portion of the shortfall would place an added drain through interest payments on the limited resources of the Road Fund. A highly leveraged program, one in which a significant portion of the ongoing project expenditures are funded from borrowings, provides a one-time opportunity to advance the timetable of future projects by making more cash available at the front-end of the program. However, in the long run, 5 percent or more of revenues are lost to interest payments. The Commonwealth should be reluctant to resolve the current imbalance in the highway program by simply borrowing money. Furthermore, borrowing would not solve the overall problem of over programming.

The use of debt is an important part of the Cabinet's financial management but should be considered only for:

- Unusually large projects whose cash flow requirements would take so much revenue from other projects that they would disrupt the overall highway program.
- Projects that have a viable business case, i.e., they will yield tangible and realizable financial savings from reductions in maintenance expenditures and rehabilitation expenditures or significantly lower construction prices that are greater than the cost of interest.

The key to identifying the latter set of projects is that cost savings must be tangible, realizable, and financial: in other words, there must be an identifiable impact on the Road Fund budget, either in reducing expenditures or enhancing revenues.

The Kentucky Turnpike Authority's outstanding debt is equivalent to about one year's worth of highway construction: in that measure, it is close to the national average and is also close to the debt levels of neighboring states. Unless new debt is issued, the Authority's current highway-related debt will be reduced. Annual debt service payments are about double what they need to be to maintain a constant level of debt, and the Kentucky Turnpike Authority estimates that outstanding highway-related debt would be reduced from almost $750 million in 2002 to about $400 million in 2007 if no new bonds are issued.

To assess its capacity for appropriation-supported debt, the Commonwealth measures the ratio of total appropriation-supported debt service costs as a percentage of revenues. Kentucky has a policy of limiting state debt such that the debt service/revenue ratio is no more than 6 percent: a limit that is prudent and in line with the practices of other fiscally conservative states. Kentucky's current outstanding debt of about $4.6 billion implies debt service obligations that are equivalent to about 5.9 percent of revenues. With its current debt service/revenue ratio very close to 6 percent, it appears that Kentucky has little capacity within that self-imposed limit for additional appropriation-supported debt.

Quantifying how much additional debt the Commonwealth can bear, and how much of that additional debt would be an appropriate part of funding the Six-Year Highway Plan, requires that the financial returns of debt-financed highway projects be balanced against the tolerance of the Commonwealth and its rating agencies for additional debt service loaded onto the Commonwealth's operating budget. This suggests that Commonwealth officials go through a process of identifying projects that are financially worthy of debt financing, then consulting with Kentucky's financial advisors and rating agencies about the capacity for additional debt for such projects. Commonwealth officials would then be able to answer in a specific and quantitative way:

- Which of the projects in the Six-Year Highway Plan from 2003 through 2008 are worthy of debt financing, in that their fiscal returns exceed the cost of debt?
- How much could be borrowed within the Commonwealth's capacity for additional debt to fund those projects?
- Which debt instruments would be most appropriate for borrowing those funds?

2. Analysis Strategy

The analysis approach involved:

- Comparison of Kentucky's past and current use of highway-related debt to the past and current use of highway-related debt in other states.
- Comparison of Kentucky's constraints on highway-related debt and on all debt with the constraints applied in other states.
- Assessment of Kentucky's current debt relative to those constraints.

3. Background: The Benefits and Costs of Debt

Governments often issue debt to fund the construction of capital assets to be used by the public. Funding assets with debt applies to the matching principle by spreading the capital costs of an asset over the period of time in which citizens reap the benefit of using it. Debt financing also has the additional benefit of easing cash flow limitations on capital formation: it allows the construction of projects to be advanced or accelerated so that their benefits can be more quickly realized.

Such benefits only come at a price. The interest paid on the funds borrowed is a real and additional cost to highway projects and the highway revenues that are used to pay interest are a lost opportunity to fund additional projects. Also, borrowing entails risks: dedicating future revenues to current highway projects can reduce a state's flexibility to respond to future needs; and adverse economic events can erode a state's ability to repay.

a. The cost implications of interest payments.

Interest payments impose a real and significant cost on highway projects and programs. Interest payments add to the all-in costs of projects which, if justified on a cost-benefit basis, can make some projects unviable. Interest payments also consume revenues that otherwise would be used to fund more projects. Both the increase in project costs and the diversion of revenue from future projects are illustrated in the following example.

A $100 million loan with a duration of 20 years and an interest rate of 5 percent will require annual debt service payments that total to about $160 million: $100 million in principal repayments and about $60 million in interest payments.

- If the borrowed $100 million were applied to a specific project (or specific projects) then the all-in cost of that project would increase from $100 million to about $160 million over the asset's beneficial life of 20 years.
- If the borrowed $100 million was applied not to specific projects but was applied to a portion of the highway program[1], then the Road Fund would have to contain a new and separate expense of about $8 million per year for the next 20 years to make debt service payments.

Either way, the interest payment component of debt service is an added burden on revenues and, in this example, about $60 million of projects would have to be removed from the Six-Year Highway Plan and from the Commonwealth's long-term plan over the next 20 years to free up sufficient revenues to make those interest payments.

b. The risks inherent in committing revenues to debt service payments.

Most highway-related debt is issued in the form of bonds with long maturities: generally about 20 years. Committing state revenues to debt service payments over these long periods would leave less revenue uncommitted and thus available to respond to changing priorities. Such reductions in the flexibility of its revenue base expose the Commonwealth in two areas of risk:

- Transportation priorities can change over time and, if revenues are committed to debt service on bonds that were used to fund past projects, then those revenues are not available to respond to the new priorities. With changes in the economy, travel demands, and other factors, the high-priority projects of 10 to 15 years ago may no longer be so urgent or so environmentally feasible as they once were. If those projects were financed through bond issues, there is little opportunity to divert the bond proceeds or the revenues required for their debt service to current transportation priorities.

[1] By depositing the loan proceeds into the Road Fund cash balance and making them available for any project.

- When states commit higher proportions of their revenues to debt service payments, they leave lower proportions of revenue available to balance their operating budgets. A principal concern of three rating agencies – Moody's, Fitch, and Standard & Poor's – that routinely rate states' bond issues is the quantity and quality of revenues that remain available after debt service requirements to respond to downturns in economic cycles and anticipated spending pressures in all programs.

4. Findings

The different ways in which these benefits, costs, and risks interplay, from one state highway program to another, or from one highway project to another, result in different states applying debt to their highway programs in different ways.

a. History of highway debt in Kentucky.

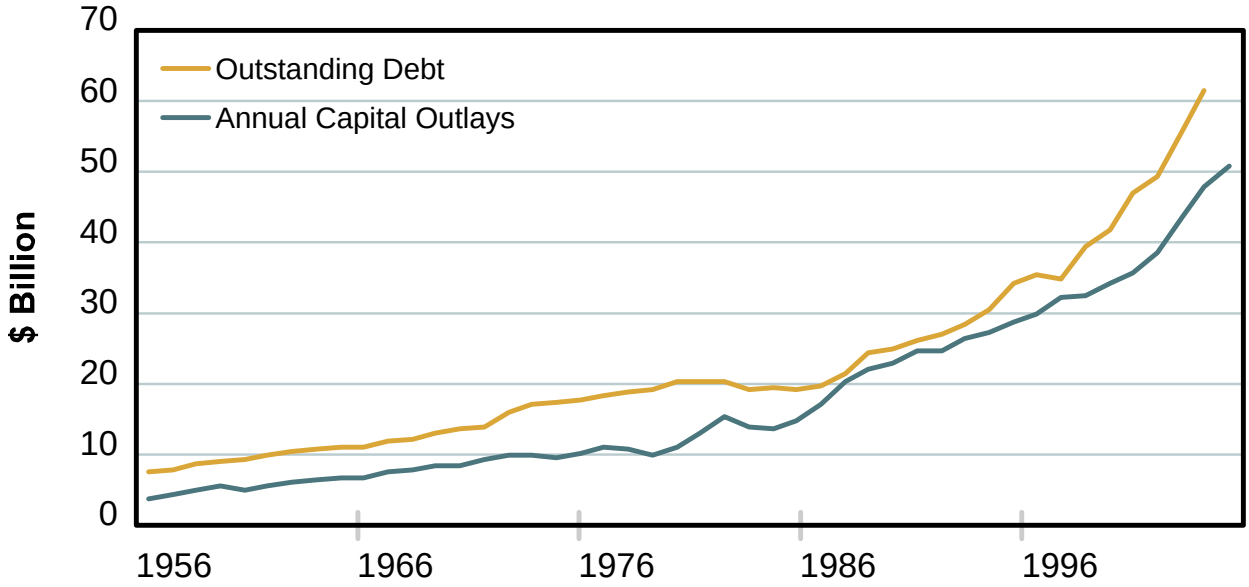
Over the past five decades, the 50 states have steadily increased their annual outlay of funds on highway capital[2] from about $4 billion in 1956 (equivalent to about $30 billion in 2001 dollars[3]) to about $50 billion in 2001. Outstanding state obligations for highway-related debt[4] also increased steadily and, since the mid-1950s, have slightly but consistently exceeded a level equal to about one year's worth of capital outlays. This seemingly steady relationship between the level of borrowing and the level of capital expenditure throughout the United States is illustrated in Exhibit IV-1 below.

[2] State-funded capital outlays on all highway systems, as reported by the states to the FHWA and compiled in Table SF-12 of the FHWA annual *Highway Statistics* publication.

[3] Federal Highway Administration, US Department of Transportation. *Price Trends for Federal-Aid Highway Construction*.

[4] Outstanding obligations of highway debt, as reported by the states to the FHWA and compiled in Table SB-2 of the FHWA annual *Highway Statistics* publication. The figures exclude the debt of toll and turnpike authorities and also exclude debt related to public transit.

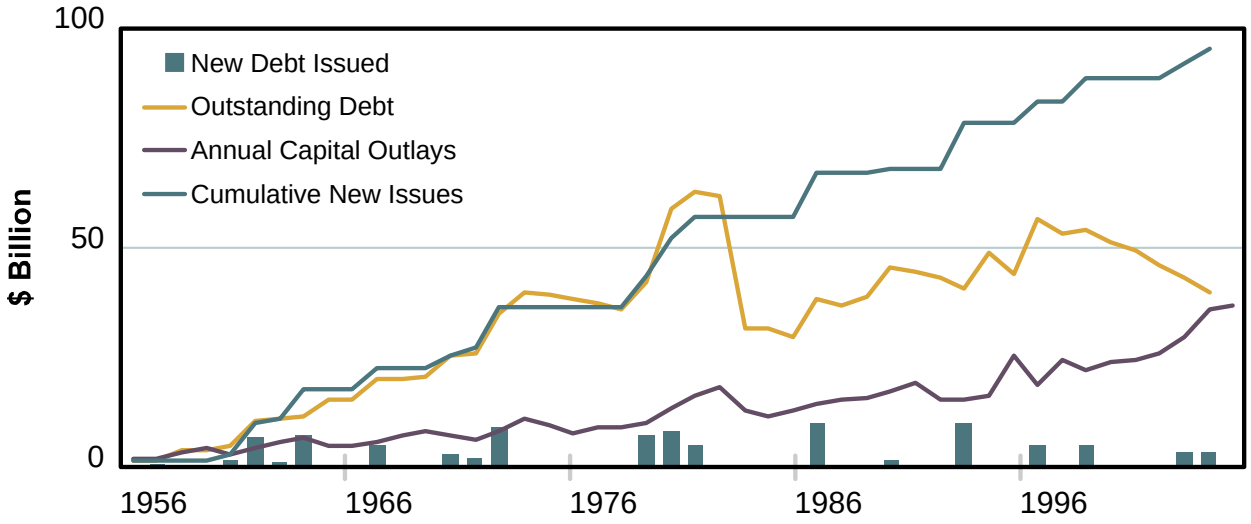
Exhibit IV-1: Annual Capital Outlays and Outstanding Debt on the Highway Programs of all 50 States[a]



[a] FHWA financial statistics, as follows:
Outstanding state highway bonds, 1956 to 1995: Available: *http://www.fhwa.dot.gov/ohim/summary95/sb202e.xlw.*
State highway bonds, change in indebtedness, 1996 to 2001: Table SB-2, *Highway Statistics*
State government capital outlays, 1956 to 1995: Available; *http://www.fhwa.dot.gov/ohim/summary95/sf202c.xlw.*
State government capital outlays, 1996 to 2001: Table SF-12, *Highway Statistics*.
Compiled in workbook "Other States Debt.XLS", worksheet "KYTC".

While state capital outlays on highways in Kentucky have reflected the national experience as a whole, the history of debt financing of highways in Kentucky is very different, as is illustrated in Exhibit IV-2 below. In addition to the capital outlays and net outstanding debt shown in Exhibit IV-1 above for all 50 states, Exhibit IV-2 also includes the amounts and years of new highway bond issues in Kentucky, year-by-year and cumulative.

Exhibit IV-2: Highway-Related Borrowing and Capital Outlays in Kentucky[a]



[a] FHWA financial statistics, as cited for Figure 1, plus new issues of debt in Kentucky from the Kentucky Turnpike Authority as reported by the Kentucky Transportation Center - Hackbart (2001). Compiled in workbook "Other States Debt.XLS", worksheet "KYTC".

Kentucky's capital outlays for highway construction have followed the pattern of steady increase that is seen across all 50 states, growing from about $60 million in 1956 (equivalent to about $450 million in 2001 dollars) to about $1.1 billion in 2001.

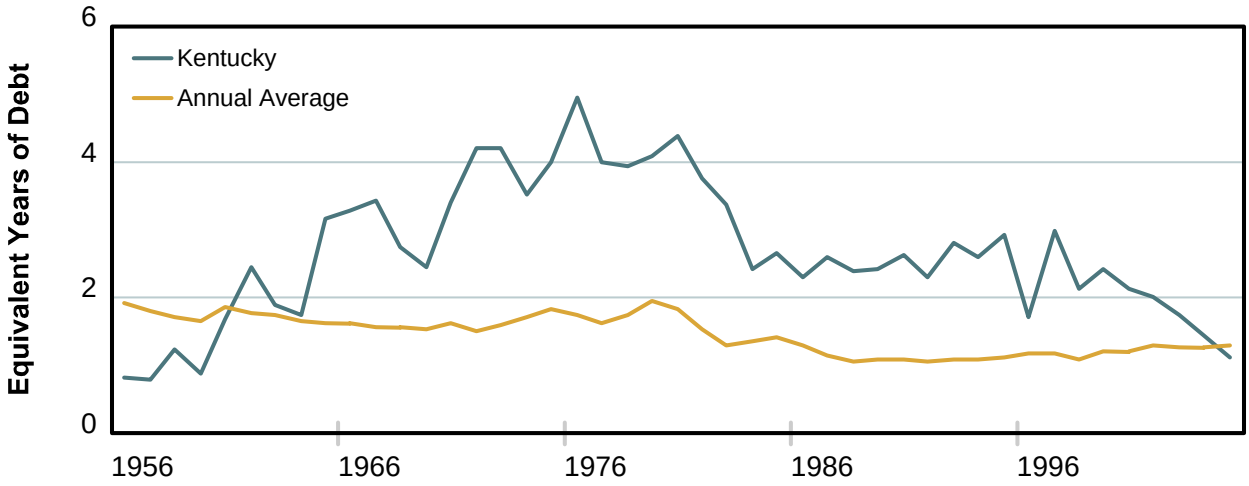
Kentucky's pattern of outstanding debt is, however, different than the overall national experience. Kentucky borrowed aggressively to fund highway construction to the mid-1970s: in 4 of the 11 years between 1961 and 1971, Kentucky borrowed amounts that were equal to or greater than the amount of all capital outlays on highways in the year during which the funds were borrowed. There was little retirement of this debt during the 1960s and 1970s, as is illustrated by the near-coincidence of cumulative new issues (the upper teal line) and net outstanding debt (the yellow line) in Exhibit IV-2.

Kentucky's policy of financing highways through debt shifted radically after 1978. Over the next two decades, Kentucky paid down much of its highway-related debt, seen in the divergence of cumulative new issues (the upper teal line) and the net outstanding debt (the yellow line) in Exhibit I-2. Most of the borrowing undertaken in the 1980s and 1990s was to refinance existing debt. From 1980 to 2001, Kentucky issued only $1.1 billion in new debt and spent almost $13 billion in capital outlays. The increased spending of the last two decades was funded increasingly from federal sources and from Road Fund revenues arising from increased fuel and highway use taxes.

b. Kentucky's use of debt to finance highways compared to other states.

With about 1 equivalent year of debt, Kentucky is not only close to the national average but it is close to the current situation of neighboring states.

Exhibit IV-3: "Equivalent Years" of Outstanding Debt, Kentucky and the National Average[a]



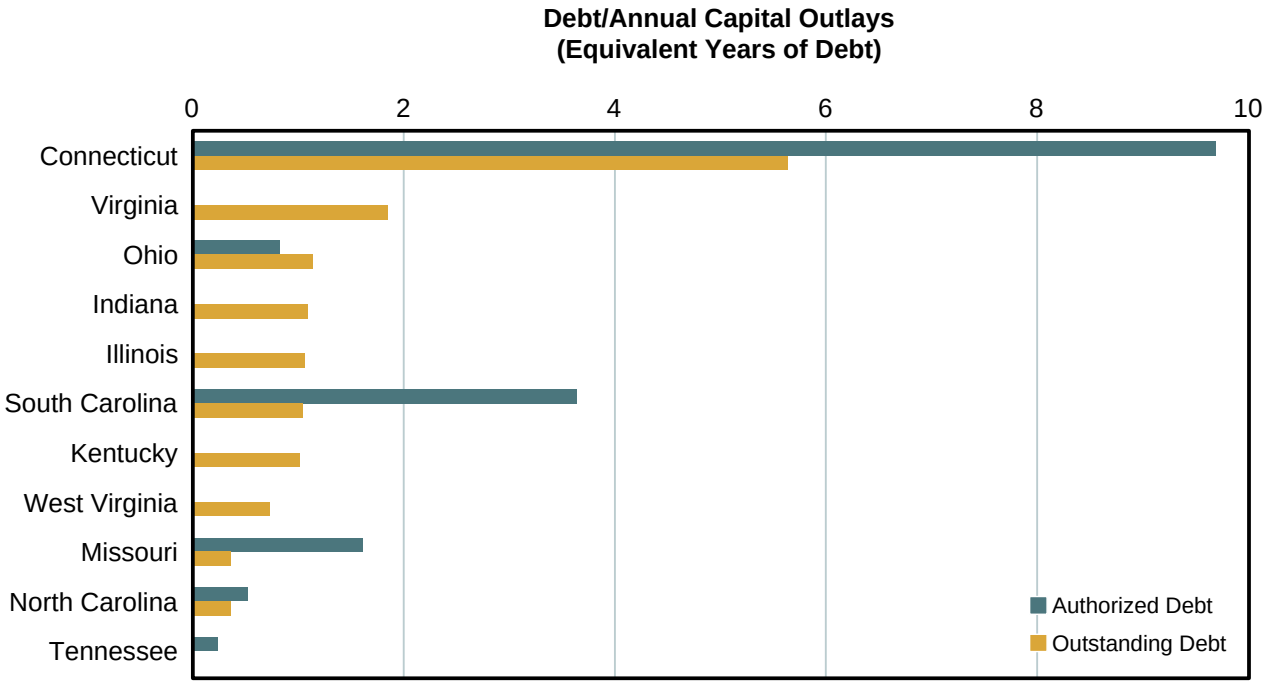
[a] FHWA financial statistics, as cited for Figure 1. Compiled in workbook "Other States Debt.XLS", worksheet "KYTC".

The category of "equivalent years of debt" is computed to enable a consistent comparison across states. So that the debt and the highway programs of small and large states can be directly compared, the outstanding debt of each state is divided by its annual capital outlays; the resulting ratio shows the outstanding debt as being equal to some years of expenditure. Kentucky, with about $1.1 billion in outstanding debt and about $1.1 billion of state capital outlay in 2001, had then about one equivalent year of debt.

Kentucky's relatively aggressive use of debt in the 1960s and 1970s and the reversal of that policy over the past 20 years is apparent in Exhibit IV-3, which compares the equivalent years of debt in Kentucky to the average of all 50 states. Only since 2000 has Kentucky's outstanding debt, relative to the size of its highway program, come down to the national average.

Within the national average of equivalent-years of debt, there is considerable variation among the individual states. Connecticut has about 10 equivalent-years of debt authorized and about 6 equivalent years outstanding. Several states have no outstanding debt. Some selected states are compared to Kentucky in Exhibit IV-4 and all 50 states are appended in Exhibit I-12.

Exhibit IV-4: "Equivalent Year" of Authorized and Outstanding Debt in Selected States



[a] FHWA financial statistics, as cited for Figure 1, and Goldman Sachs (2003). Note that these data do not include debt related to turnpikes or other toll facilities. In 2001, there were about $12 billion of outstanding toll-related debt across the nation, of which about ½ was in California. Workbook "Other State Debt.XLS", worksheet "Selected States".

Connecticut is shown as a long-time and, currently, the most aggressive user of debt. South Carolina is shown to be shifting that way: it has authorized but not yet issued a considerable amount of debt. All the other states are selected for their proximity to Kentucky. Exhibit IV-4 shows that, with about one equivalent year of debt, Kentucky is not only close to the national average but also to the current situation of its neighboring states.

c. Kentucky's capacity for highway-related debt.

Within any state's overall debt there can be and will be considerable variation in the amount of debt carried for specific programs. A program that distributes adult training grants, for example, would likely have no debt associated with it, whereas a capital-intensive program such as highway construction will often have associated debt that exceeds the debt service/revenue ratios for the government as a whole. For this and other reasons most states have accounting entities separate from their general funds for their highway construction programs. The debt carried by the Kentucky Turnpike Authority and associated with the Road Fund is summarized in Exhibit IV-5.

Exhibit IV-5: Debt Service, Revenue and Debt Service Coverage in Kentucky - Road Fund[a]

	Kentucky Turnpike Authority ($M)
Outstanding Appropriation-Supported Debt, Dec. 2003	739
FY 2004 Debt Service Payments	164
FY 2004 Road Fund Revenues	1,123
Debt Service as a Percentage of Outstanding Debt	22.2%
Debt Service as Percentage of Revenues[b]	14.6%

[a] Outstanding debt and total revenues from Office of Financial Management, Commonwealth of Kentucky. *Outstanding Debt of the Commonwealth, as of December 31, 2003*. Available: http://www.ofm.state.ky.us/outstand-debt.html. Road Fund revenues from Office of the State Budget Director, Commonwealth of Kentucky. 2002-2004 *Budget In Brief. Available: http://www.osbd.state.ky.us/0204Budget.htm*.

[b] In the road funds of most states, some portion of collected highway revenues are diverted to programs other than highway construction: e.g. administration, grants to municipalities for local roads, and sales tax compensation transfers to general funds. In Kentucky, there are roughly $400 million per year of these diversions, leaving about $700 million of "restricted revenues" available for TIP capital projects and additional debt service. As a percentage of "restricted revenues," current highway-related debt service costs are about 25 percent in Kentucky. Throughout this paper, ratios are measured against full revenues, as this is the most common standard in debt reporting and bond rating.

The ratio of debt service to outstanding debt is an indicator of whether Kentucky is drawing down or building up its highway-related debt. That ratio is close to 20 percent where in a steady-state debt portfolio, in which the amount of outstanding debt does not change in the long run, it would be about 10 percent.[5] The Kentucky Turnpike Authority plans principal repayments of more than $450 million between FY 2004 and FY 2008 which, assuming that no new debt is issued in that five-year period, will reduce outstanding highway debt to less than half of the current balance.

The relationship between debt service and available income is expressed in certain financial ratios, such as "debt service as a percent of total appropriations" or "debt coverage ratio." The ratio of debt service to revenues is a principal indicator of a state's capacity to assume and carry debt. At 15 percent, Kentucky debt service/revenue ratio is in the company of most states with highway-related debt service/revenue ratios that are substantially higher than its ratios for overall debt. Several of these other states have authorized limits for highway-related debt that are separate from and higher than their overall debt limits, either in enabling legislation or in the minimum revenue coverage ratios in specific bond issues. Connecticut is the highest at 50 percent. Michigan has a legislated limit of 50 percent, an operating guideline that allows up to 25 percent but has not, to date, exceeded 15 percent. Missouri's highway bonds are "stand-alone," meaning that

[5] Assuming an interest rate of 5 percent, a debt portfolio comprised of 20-year bonds would require principal repayments of a further 5 percent per year to retire debt at the same rate at which new debt is issued.

they can be paid only from Missouri's Road Fund revenues; their current ratio is 15 percent but is authorized to go as high as 30 percent.[6]

The experience of these other states, and Kentucky's own history of highway-related debt, suggest that Kentucky could significantly increase its highway-related debt and maintain a debt service/revenue ratio that is in the company of these other states. Such an increase would, however, have to be accommodated within the Commonwealth's limitations on debt across all of its programs. As is outlined below, the limits on the total of Kentucky's appropriation-supported debt are a more severe constraint on issuing new highway-related debt than is the debt-bearing capacity of the Road Fund.

d. Kentucky's capacity for appropriation-supported debt of all types.

There is no dollar limit in the legislated authority under which the Commonwealth of Kentucky issues highway-related appropriation-supported debt. Legislated limits on highway debt are based in process: the Kentucky Turnpike Authority cannot issue any debt until the associated capital project is approved and the revenues for debt service are appropriated by the General Assembly.[7]

The more relevant limitation on appropriation-supported debt in Kentucky is the burden that debt service places on the revenue appropriations that must pay them. The current ratios for Kentucky's outstanding appropriation-supported debt are summarized in Exhibit IV-6.

[6] The cost of debt service is one-half of the debt service/revenue ratio; the other one-half is revenue. Revenues vary considerably from state to state, both in tax rates and in amounts collected. A debt service/revenue ratio could be high in a particular state not necessarily because outstanding debt is high but because revenues are relatively low. Whether Kentucky's highway revenues are low relative to the Commonwealth's transportation needs or relative to those of other states is a relevant question but beyond the scope of this review.

[7] Kentucky Revised Statutes (KRS) 175.410 through 175.990.

Exhibit IV-6: Debt Service, Revenue and Debt Service Coverage in Kentucky - All Funds[a]

	All State Agencies ($M)
Outstanding Appropriation-Supported Debt, Dec. 2003	4,625
FY 2004 Debt Service Payments	609
Total FY 2004 Appropriation-Supported Revenues	10,344
Debt Service as a Percentage of Outstanding Debt	13.2%
Debt Service as a Percentage of Revenues	5.9% [b]

[a] Outstanding debt and total revenues from Office of Financial Management, Commonwealth of Kentucky. *Outstanding Debt of the Commonwealth, as of December 31, 2003*. Available: *http://www.ofm.state.ky.us/outstand-debt.html*. Road Fund revenues from Office of the State Budget Director, Commonwealth of Kentucky. *2002-2004 Budget In Brief. Available: http://www.osbd.state.ky.us/0204Budget.htm*.

[b] Outstanding debt and total revenues from Office of Financial Management, Commonwealth of Kentucky. *Outstanding Debt of the Commonwealth, as of June 30, 2003 reports this figure as 4.2 percent.* However, Legislative Research Commission staff advise that the debt service payments reported there exclude payments into debt retirement reserves, which they include in their calculations of debt service/revenue ratios.

The ratio of debt service to outstanding debt is close to 13 percent, what that ratio would be in a steady-state debt portfolio in which the amount of outstanding debt does not change in the long run.[8]

Legislative Research Commission staff advise that, in the past as a policy objective, Kentucky has limited its total appropriation-supported debt so that the debt service does not exceed 6 percent of state revenues. There are no hard and fast technical limits on this ratio; in each jurisdiction in which it is applied, it encapsulates the decisions of policymakers (which, presumably, reflect the collective preference of the citizens they represent) about borrowing and saving. The World Bank notes:

> Sustainable debt principles…argue that the proportion of revenues allocated to debt services must be limited by the debt service tolerance of a jurisdiction's constituents. How high the limits of debt service tolerance varies, state interest payments in the U.S. average 4 percent of revenues; in Germany 8 percent and in Canada, 12 percent.[9]

From this perspective of collective preference, there is no basis from which to suggest that Kentucky's self-imposed 6 percent limit of the Commonwealth's debt service/revenue ratio is inappropriate.

[8] Assuming an interest rate of 5 percent, a debt portfolio comprised of 20-year bonds would require principal repayments of a further 5 percent per year to retire debt at the same rate at which new debt is issued.

[9] Dillinger (2000).

With its current debt service/revenue ratio very close to 6 percent, it appears that Kentucky has little capacity within that self-imposed limit for additional appropriation-supported debt. Further, it appears that this global limitation may restrict the amount of new highway-related debt to an amount that is lesser than that could be borne by Road Fund revenues.

Estimating what these numbers are – the additional debt that could be borne by the Road Fund and the additional debt that could be assumed within Kentucky's 6 percent limit on its debt service/revenue ratio – is best left to Commonwealth officials for several reasons:

- Commonwealth officials have comprehensive knowledge as to what debt and other obligations must be included when calculating Kentucky's debt service/revenue ratios.
- Kentucky has access to pre-qualified financial advisors and to bond rating agencies who can be directly consulted on the extent to which additional debt issues might drive up the marginal cost of Kentucky's debt or affect the Commonwealth's bond ratings.
- The advice of those financial advisors and rating agencies will to some extent depend on the tangible financial benefits that are associated with the highway projects that may be proposed for debt financing.

5. Available Instruments

When the Commonwealth of Kentucky has used debt for financing highway construction in the past, it has assumed that debt in the form of state-issued bonds. In this section, some other forms of debt that the federal government have made available to all states are described.

The Federal Highway Administration of the United States Department of Transportation (the FHWA) has developed a several new forms of credit since the passage of the *Intermodal Surface Transportation Efficiency Act* (ISTEA) in 1991 and promotes them under the covering term: "innovative financing." Several of these forms of credit may have some potential application in Kentucky.

Before describing these forms of debt, we emphasize that, innovative or not, they are still debt. While some of them offer advantages relative to the alternative of appropriation-supported debt, they are all accompanied by the costs of debt: the real costs of interest and the opportunity costs of committing future revenues to current projects. Our general recommendations about the judicious and appropriate use of debt in a state highway program also apply to these "innovative" forms of debt as well as to state-issued, appropriation-supported debt.

a. Innovative financing: debt instruments and credit assistance.

FHWA offers the following list of debt instruments and credit assistance to state DOTs for funding highway programs.

(1) Grant anticipation revenue vehicles (GARVEEs).

When states issue bonds, they must pledge revenues towards their repayment. If more revenues are available to be pledged, then more bonds can be sold.

Up to 1995, the federal funds received by states for federal-aid eligible projects could only be pledged towards bonds in very limited ways. Now, the same rules that allow for advance construction with federal funds over long periods also allow the future federal appropriations that are expected over those longer periods to be pledged as revenues to bonds.

GARVEEs take the forward commitment of federal appropriations to bonds one step further: once the FHWA has approved a project or program for a GARVEE, and the state has issued a bond with those future appropriations pledged against it, the state may elect to bill the FHWA for the federal portion of the debt service payments on the bond rather than the federal portion of cash payouts on the project or program.

A GARVEE is still a state-issued bond and is classified by the issuing state as "on-book" debt, i.e. as direct debt. Because federal aid receipts are among those revenues included in the debt service/revenue ratio, GARVEE bonds fall inside the Commonwealth's cap of a maximum 6 percent debt service/revenue ratio.

A GARVEE may be issued on a non-recourse basis with the issuer pledging only future federal-aid funding as security. However, states may also choose to pledge additional revenues, such as state motor fuel taxes, thereby enlarging the revenue base from which the bond is to be repaid. This reduces the risk of default and, as a result, usually is recognized with higher bond ratings and lower interest rates.

GARVEES are used to their best advantage in two situations:

- When a very large federal-aid project or program has cash flows so voracious that borrowing is necessary to prevent other programs from being starved of revenues. Without a GARVEE, the large project or program would have to be funded with a state bond backed by state revenues; the federal funds for that project or program would only be forthcoming after the FHWA had been billed for project expenditures. When a GARVEE is used, state funds no longer need to be advanced to initially fund the entire project or program cost. Starting in 1998, Ohio issued $130 million in GARVEE bonds for such projects and, by

applying toll credits to meet the state match requirements, did not encumber any state revenues to fund them.

- When legislative authority exists to issue highway-related bonds but a subsequent vote of the people has denied the state the authority that it needs to pledge state revenues to those bonds. Such a denial in 1995 sparked a $375 million GARVEE-based borrowing program in Arkansas.

(2) State infrastructure banks (SIBs).

A state infrastructure bank is a revolving fund whose initial capital was funded from federal apportionments. The FWHA provides credit assistance, through that initial endowment, to any highway projects that draw all or part of their funding from the state infrastructure bank.

Many governments and large corporations use revolving funds for ongoing generations of capital projects. The government or large corporation provides its revolving fund with an initial endowment of capital as its opening balance. Thereafter, it operates as an internal bank within the organization and loans out funds to a generation of projects; as that generation repays the borrowed funds to the internal bank, the funds are loaned to succeeding generations of projects. The internal bank often charges an internal interest rate to cover its administrative expenses and, in some cases, to build earnings that might offset losses on failed projects that cannot repay their loans.

States have used revolving funds for their highway programs for many years but, prior to 1995, they could not use federal funds as part of the initial capital provided to a revolving fund. States could only use federal funds that were received on federal-aid eligible projects to repay advances to those projects from the revolving funds. Since the passage of the National Highway System Designation Act 1995, eligible states can use up to 10 percent of their federal apportionment as initial capital for a state infrastructure bank, providing that they also endow matching state funds.

Some internal banks lever their initial capital injection, using it as equity and borrowing additional funds from external sources. Only a few of the 32 state departments of transportation that have revolving funds have levered their initial capital with subsequent bond issues: South Carolina is one of them, having issued state revenue bonds to boost its infrastructure bank assets to over $2 billion, so that it can fund large projects with budgets over $100 million.

(3) Direct federal credits (TIFIA).

The *Transportation Infrastructure Finance and Innovation Act* (TIFIA) 1998 allows the FHWA to participate as a creditor in specific and eligible projects

up to 33 percent of the project's value. TIFIA credits differ from GARVEEs and SIBs in several ways: TIFIA credits are applied to specific projects on their financial merit, and FHWA participates directly as a financing partner in the project rather than as a source of funds that are administered by states.

The policy objective of TIFIA credits is to boost financial feasibility of surface transportation projects that are on the margin of commercial creditworthiness, such that those projects can attract investment from other sources: without the TIFIA credit, the amounts to be borrowed are too great to be sustained by the revenues that the project is expected to capture. The TIFIA credit reduces the remaining balance to be funded through borrowing such that this remainder can be funded with commercial borrowing against which only the project's revenues are pledged. The clear implication is that only projects that generate revenues are eligible for TIFIA credits. A TIFIA is credit assistance from the USDOT and does not draw from federal funds apportioned to states. One of the largest TIFIA credits to date involves a $2.1 billion highway and transit facility in and around Miami-Dade Airport, with revenues coming from airport lessees, transit users, and rental car surcharges.

The forms of TIFIA credits follow their policy function: they are direct loans, loan guarantees, or lines of credit that take the place of "junior" or subordinated debt on a project, akin to a second mortgage on a home. TIFIA credits must, however, contain a "springing lien" provision: in the event of insolvency, the TIFIA credit rises from its subordinate position to take on rights to revenues that are equal to those held by the senior creditor of the project. There has been much debate about the effects of the "springing lien," an example of which is a $215 million TIFIA credit in the $700 million Cooper River bridge replacement in South Carolina. The project revenue source is a surtax on tourism facilities and, to protect the local municipalities that collect it from the springing lien, South Carolina had to back the TIFIA with state revenues.

(4) Section 129 loans.

With the passage of the *Intermodal Surface Transportation Efficiency Act* (ISTEA) 1991, state departments of transportation could loan funds from their regular federal apportionments to federal-aid eligible projects that had sufficient dedicated revenues to repay the loans, then apply the repaid funds on the usual grant basis to another federal-aid-eligible project.

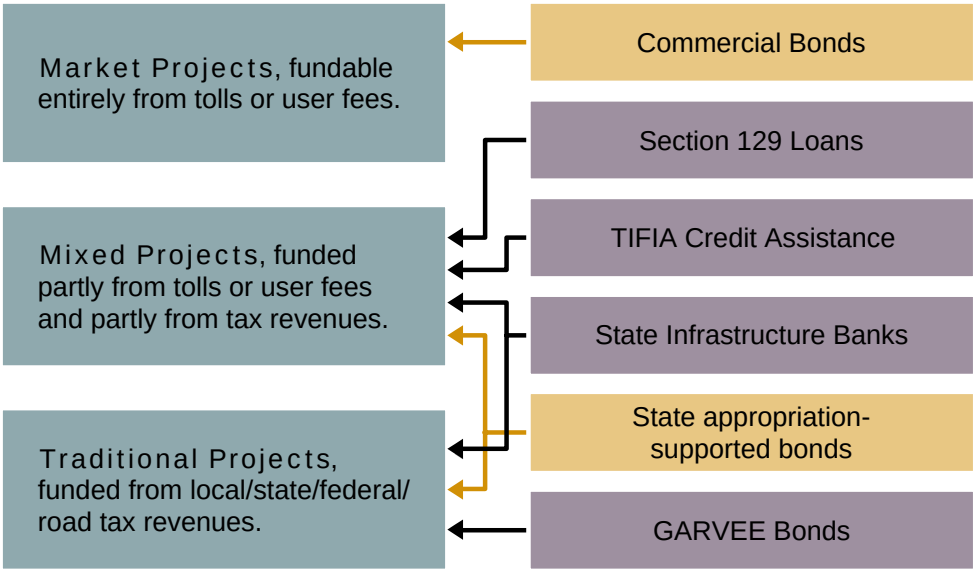
The policy objective of section 129 loans is to encourage more federal-aid eligible projects to be funded from other revenue sources. The dedicated revenue can be a toll or user fee from any state or local source but could not be federal revenue.

Section 129 loans are best applied to turnpikes and other tolled roads that can fully repay their capital costs from their own revenues. Texas loaned about $135 million of its Surface Transportation Program apportionments to the authority building a new turnpike in the Dallas – Fort Worth area.

b. General features of innovative financing debt instruments.

The following diagram paraphrases the FHWA representation of how these debt instruments are best applied against projects, differentiated by how much of the revenue required to pay for these projects is paid by users, as opposed to taxpayers.

Exhibit IV-7: Alignment of Innovative Financing Debt Instruments to Highway Projects[a]



[a]Adapted from Figure 1.1 in the *FHWA Innovative Finance Primer*.

Conventional forms of debt - appropriation supported state bonds and commercial "stand-alone" bonds - are also shown for comparative purposes.

The differentiating features of the different sources of debt suggested by the FHWA are summarized in Exhibit IV-8.

Exhibit IV-8: Features of Innovative Finance Debt Instruments

	GARVEE Bond	SIB Loan	TIFIA Loan	S. 129 Loan
Maximum share of financing in a project.	80%	80%	33%	80%
State match required.	20%	20%	No	Loan 100%, then 0%
Additional taxes tolls or fees required?	No	No	Yes	Yes
Local government participation required?	No	No	Sometimes	Usually
Private sector partner required to be present in project?	No	No	Usually	No
Interest rate higher, the same or lower than state bonds?	Same	Same	Higher	Same
Administering agency for credit and payments.	State	State	FHWA	State

All of these funding sources require additional legislative authority to borrow the necessary funds. Usually the debt would be included as state debt in the state's credit rating. All of these funding sources involve a significant increase in the overall cost of the project due to interest, issuing costs, and administrative costs.

There are other financing opportunities in which federal funding can play a part, such as private-public partnerships and government toll authorities that are eligible for IRS 63-20 loans.[10]

c. FHWA innovative financing and state-match programming.

The United States government collects a federal gas tax to fund the U.S. Highway Trust Fund, from which state governments receive funds for their highway programs. Like all states, a significant portion of Kentucky's Road Fund revenue comes from the federal government: $2.9 billion of the $4.7 billion of revenue anticipated in the 2003-2008 State Highway Improvement Plan are federal receipts.[11]

There are many restrictions and conditions on federal highway funding that create challenges for states as they program their transportation improvement plans. Federal highway funds:

[10] A 1963 Internal Revenue Service ruling that allowed certain government-owned, non-profit corporations the same exemption of investors' interest payments from federal income tax as is allowed on municipal bonds.

[11] Kentucky Transportation Cabinet. Funding Chart 4, *Revenue Assumptions for FY 2003-2008 Six Year Highway Program*. Available: http://transportation.ky.gov/progmgmt/2002syp.html.

- Are *program-specific*, in that federal funds are divided among many different programs which permit only specific types of projects, contain deductions and "earmarked" funds for specified planning activities, must be distributed throughout the regions of each of the states, and the projects themselves must be approved by the FHWA.
- Require *cost-sharing*, in that, most commonly, 80 percent of the expenditures on federal aid-eligible projects can be funded from federal aid, requiring a contribution of state funds to "match," or complete the balance of 20 percent.
- Are *reimbursements*, in that, to receive federal funds for a federal-aid eligible project that has been approved by the FHWA and upon which work has commenced, the state must first pay the construction contractor 100 percent of what is owed entirely with state funds then bill the FHWA for reimbursement of the federal share – usually 80 percent.

These and other restrictions create significant challenges for the state officials who are responsible for highway programming as they struggle to ensure that all the federal funds to which a state is entitled are used ("Never send a dollar back to Washington" is the catch-phrase of highway programmers) and to fund the "state match" for federal aid-eligible projects.

The FHWA recognizes the difficulties caused by these restrictions on programming federal funds and matching state funds to federal-aid projects. Under the banner of "innovative financing," the FHWA has offered some variations and exceptions to them, briefly summarized here:

- **Advance construction**, a cash flow management tool in which the state uses its own funds to fully fund and proceed with a federal-aid eligible project that will only be eligible for its apportionment of federal-aid funds in some future year, when the state funds so used can be converted to federal funds.
- **Partial conversion of advance construction**, in which only some of the state funds used in the advance construction of a federal-aid eligible project are converted to federal funds in a given year.
- **Tapered match**, in which the requirement for the state to match federal funds is applied to the project as a whole, rather than on every individual payment of federal funds, allowing states to "back-end load" the payment of the required state-match funds into the payments that occur towards the end of construction.
- **Flexible match**, in which specified non-cash contributions from the state, from local government, or from private sector partners are allowed as contributions towards the match requirements of a federal-aid eligible project.
- **Toll credits**, in which those states that, in past years, used toll revenues to fund state highways that were used to the benefit of interstate commerce are granted credits equal to a portion of their continuing state expenditures on

those highways, and permitted to apply these credits in lieu of cash to meet the state matching requirement on other, federal-aid eligible projects.

- **Off-system bridge credits**, in which state funds spent on certain off-system bridge projects can generate credits, similar to toll credits, that can be applied in lieu of state or local cash contributions to federal-aid eligible bridge projects.

Kentucky has a sizable balance of toll credits, over $1 billion, and the Cabinet can use them, along with advance construction and partial conversion, in meeting its state match requirements. It is important to remember that toll credits are not cash. While substituting toll credits for state revenues in state match contributions will free up state revenues for projects that are not eligible for federal aid, they will not increase the amount of cash available for all projects.

The inability of toll credits to increase cash availability of the number of projects funds is illustrated in the following example of how $100 million in state revenues and $100 million in federal revenues can be applied, with and without toll credits, across federal-aid and state projects.

Exhibit IV-9: An Example of the Use of Toll Credits in Highway Program Funding

$ Millions	State Match from State Revenues	State Match from Toll Credits
Federal-Aid Projects		
Federal Revenues (cash)	100	100
State Revenues (cash)	25	0
Toll Credits (non-cash)	0	25
Total Federal Aid Projects	**125**	**100**
State Projects		
State Revenues	75	100
All Projects (cash)	**200**	**200**

The net effect of toll credits is to reduce the funding of the federal-aid projects, increase the funding of state projects, and leave the total spent on all projects unchanged. In this example, the toll credits allow $100 million of federal aid projects to proceed with a $25 million cash state match. However, the total amount spent on federal aid projects must be reduced by $25 million, as state cash is no longer committed to those projects. An additional $25 million is made available for state projects. Because toll credits bring no cash, the total funds available for all projects in the highway program are not increased above $200 million of cash that is available from state and federal revenues.

B. Question 2: What is the nature of the current over programming of the Six-Year Highway Plan and how should the current shortfall be resolved?

The Cabinet has provided a number of briefings and reports to the General Assembly detailing the current estimated level of over programming in the Six-Year Highway Plan.[12] There is widespread agreement on the cause of the over programming. Namely, at the time of the 2000 Session, the Six-Year Highway Plan was over-committed and Governor Patton proposed a 7-cents-per-gallon increase in the motor vehicle fuels tax. This tax was not enacted but $1 billion of projects that it would have funded were in the plan. This was exacerbated by an overestimate of revenue for state projects in 2000. Also, the Cabinet received authorization to use cash flow financing from the Road Fund balance to accelerate the program. This has taken place and the Cabinet is performing active cash management. Given that there is broad consensus on the factors that caused, and the extent of, the over programming, the most significant issue is how to resolve the shortfall.

1. Answer

Resolution of the over programming problem requires a combination of policy, program management, and financial management actions. At the policy level it involves establishing a new level of trust between the Cabinet and the General Assembly and commitment to bring best management practices to bear so that the implications for the performance of the transportation system are explicitly considered in the budget process and associated decision-making. At the program management level, it requires establishing a program that is truly delivered in the planned time frame and for which the Cabinet is held accountable. It requires prudent fiscal management and financial management practices such that the program is cash feasible and debt is used prudently.

The current over programming can not be resolved by borrowing funds. There is not sufficient debt capacity. The recommended solution is to produce a new cash feasible and financially constrained Six-Year Highway Plan that is established using best planning and programming practices recommended in Section III, “Project Selection and Prioritization.” The solution involves taking the existing set of projects that are in the Six-Year Highway Plan and prioritizing them against a set of policy and planning objectives for Kentucky’s transportation system. Where debt finance is warranted because of the financial benefits to the Highway Fund, it should be used to advance the projects in the current Six-Year Highway Plan.

[12] The most recent are the September 29, 2003 Cash Management Spending Plan and the monthly reports of the Current Six-Year Highway Plan Funding Status.

To implement this solution will require agreement, buy-in, and trust between the stakeholders. Implementation requires establishing a transition strategy from the current set of Six-Year Highway Plan projects to a new set that involves the principal stakeholders from the Transportation Cabinet, the Governor's Office, and the General Assembly working to establish agreement on the policy basis for reprioritization. In turn, the Transportation Cabinet needs to provide technical input to explain what the Commonwealth is buying in terms of transportation system performance based on the prioritization approach.

2. Analysis Strategy

The following analysis approach was taken:

- Interviews were conducted with Cabinet managers.
- Cabinet budget documents and reports were assessed.
- Programming practices were reviewed.

3. Findings

- **The Six-Year Highway Plan is over programmed by $1.94 billion of which $1.26 billion is programmed for state projects.**

  The magnitude of the over programming is well documented. The Six-Year Highway Plan is organized by funding category and it is the state projects category that is most heavily over programmed in the amount of $1.26 billion.

- **There are systemic pressures that create over programming.**

  Although it is clear that a significant portion of the over programming arose because projects were added based on the assumption of a 7 cents per gallon increase in the motor vehicle fuel tax in the 2000 session, there is a systemic pressure on the plan that results in over-commitment. One of the reasons for the proposed tax increase was that the Six-Year Highway Plan was over programmed. Projects have continued to be added into the plan, further exacerbating the problem.

  The systemic problem is that much of the decision-making regarding prioritization now takes place at the biennial budget level and that is where fiscal constraint takes place. There is a widespread belief that until the project is in the budget it will be subject to slippage. Further, when projects make it into the biennial budget that were not in the Six-Year Highway Plan and as other project requests are met by adding projects to the Six-Year Highway Plan, the over programming is exacerbated.

- **Funding source and funding category drives the overall program structure as opposed to policy and planning objectives.**

  The Six-Year Highway Plan is organized around funding category as opposed to programmatic objectives such as system preservation, mobility, or other factors. Therefore, it is difficult to assess the implications of funding decisions or the outcome of not having funds for the over programmed projects. Best practice is to determine the policy and planning objectives and then align projects and their associated funding sources to support those objectives.

C. Question 3: How effective are the measures that the Transportation Cabinet has taken to perform cash management in the current fiscally constrained environment?

As recently as 2000, the Road Fund had an average cash balance of approximately $650 million. This balance was due to the substantial lag between the obligation of funds by budget appropriation or budget allotment and their expenditure. This situation arises because funds are obligated for projects that subsequently take a number of years to be expended. The General Assembly provided the Cabinet the authority to cash flow projects using the unexpended balances in the 2000 to 2002 biennial budget. This continued with the 2003 to 2004 biennial budget but with the requirement that the "Transportation Cabinet shall maintain a minimum Road Fund cash management target of $100 million." The Road Fund balance in September 2003 was down to approximately $230 million and is projected to fall further. In this environment, a key issue for the General Assembly is whether the Cabinet has effective management controls, tools, and procedures to perform cash management.

1. Answer

Yes, the Cabinet has implemented a best practice approach to cash management. The management controls, technical support, and accountability mechanisms are all in place to perform active cash management. The Cabinet has designed and implemented revenue and expenditure forecasting and monitoring tools that provide monthly cash flow forecasts. The forecasting models and procedures are robust, well designed, and have been implemented effectively. In addition, the Cabinet has established a senior level management team that uses this information to actively manage cash and make decisions regarding program acceleration or deceleration.

2. Analysis Strategy

The following analysis approach was taken:

- Interviews with Cabinet managers.

- Review of forecasting and monitoring procedures.
- Evaluation against best practice drawing upon Dye Management Group, Inc. prior cash management work for state departments of transportation.[13]

3. Findings

- **The Transportation Cabinet's models predict that cash balances will fall below $100 million in 2004 requiring a cash management plan.**

  Beginning in fiscal year 2001, the Cabinet began to cash flow projects. A prefinancing provision in the 2000 to 2002 biennial budget, enacted by the General Assembly, authorized the Cabinet to develop and implement a program to accelerate projects. This was accomplished by suspending Kentucky Revised Statutes (KRS) 45.242 "Unauthorized allotment obligations" and KRS 45.244 "Obligations not authorized by appropriation or budget." These prefinancing provisions provided the Cabinet with the one-time opportunity to advance additional projects.

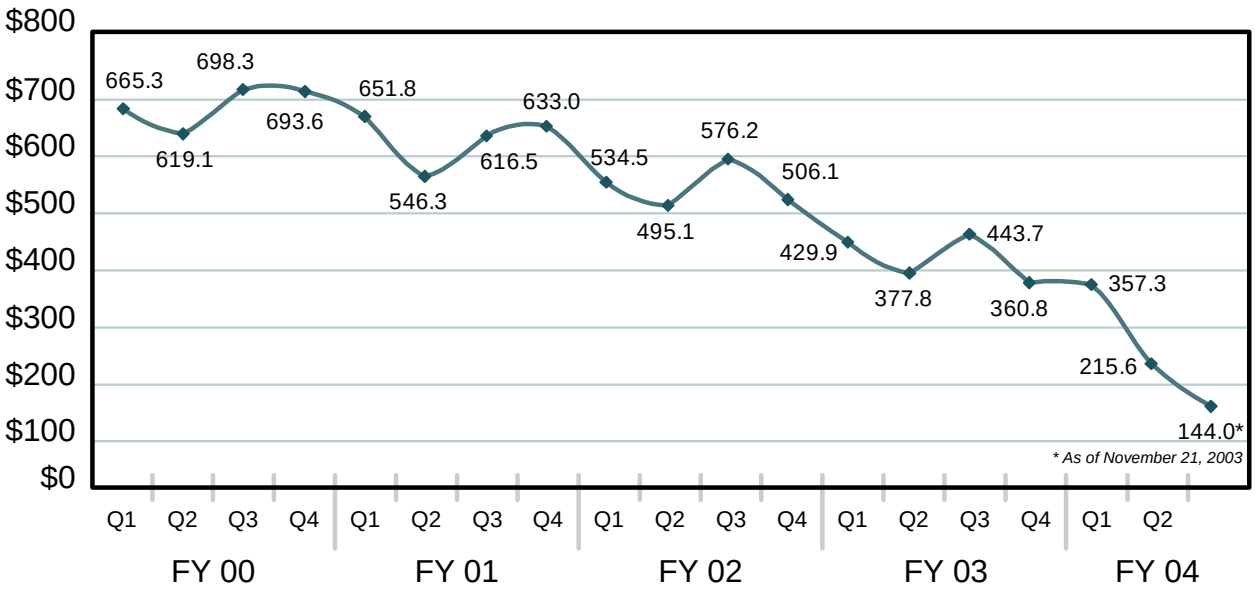
  The prefinancing provisions were continued with the 2003 to 2004 biennial budget; however, the General Assembly added the additional provision that the Cabinet shall maintain a minimum Road Fund cash management target of $100 million. In addition, the following requirement was enacted:

  > The Secretary [of the Transportation Cabinet] is directed to continuously ensure that the unspent project and Road Fund balances available to the Transportation Cabinet are sufficient to meet expenditures consistent with appropriations provided. The Transportation Cabinet shall maintain a minimum Road Fund cash management target of $100,000,000. The Secretary may seek approval to spend Road Fund monies below $100,000,000 by submitting a recommended spending plan to the Secretary of Finance and Administration for approval.

  This requirement has now been triggered by the Fiscal Year 2005 cash flow forecast that forecasts a cash balance below $100 million from June 2004 to April 2005.

[13] North Carolina General Assembly: Cash Management Review, Dye Management Group, Inc. 2000. North Carolina Department of Transportation: Cash Management Tools and Procedures 2003.

Exhibit IV-10: Gross Road Fund Cash Balance (millions)



- **The Transportation Cabinet has established a Cash Management system and instituted appropriate management controls.**

  The following best practices for cash management have been established:

  – Executive level direction and oversight.

  – Development and use of financial tools and reporting procedures.

  Executive level oversight. The best practice is to establish strategic objectives, performance targets, accountability mechanisms, and senior management teams responsible for cash management. Accomplishing these objectives is a task for the senior management team who are collectively accountable and responsible for their accomplishment.

  Cash is actively managed by a senior management team in states that are successful in accomplishing their cash management objectives. Best practice involves senior management with responsibilities for the major factors that impact current and future cash positions. Generally, senior management teams are involved in active cash management through monthly and more frequent meetings. The team's role is to monitor and update the letting schedule and longer term delivery plans and actively bring together planning, project delivery, and finance to manage cash.

  The Cabinet has established the Authorization Review Team to provide this management oversight. This is a senior management team that meets twice

a month to provide oversight to project delivery decisions that will impact the Cabinet's cash position.

Financial tools and reporting procedures. Best practice requires the capability to forecast and monitor revenues and expenditures on an ongoing basis. Best practice involves cash management forecasting and monitoring capability that can account for the following components:

- Cash-flow impacts of program delivery.
- Revenue forecasts and actual expenditures.
- Contractor payments.
- Project change orders.
- Accrued unbilled amounts on federally funded projects.
- Advanced construction decisions.
- Reimbursement schedules on federally funded projects.
- Contract maintenance and other non-Six-Year Highway Plan contractor payment schedules.
- Debt service.
- Payments not directly related to project activities, for example payroll.

The Cabinet has developed a sophisticated revenue and expenditure forecasting model that accounts for these components.

The level of complexity of the models used by other states varies. Best practice involves having an effective cash forecasting system. The system used by states typically involves revenue forecasting models, program delivery plans, and expenditure forecasting models. The models require different levels of accuracy and are used for three main purposes:

Day-to-day monitoring of cash balances. States that manage cash aggressively monitor cash balances on a day-to-day basis. The ability to use short-term borrowing reduces the need for Kentucky to perform this type of cash management or treasury function.

Month-to-month cash forecasting. States with active cash management have implemented a month-to-month "dynamic" cash forecasting and monitoring process. Dynamic cash-flow models update forecasts every month, or more frequently, as new actual data is recorded. In this sense, the cash forecast then becomes a "rolling" forecast. This replaces annual budget or forecast expenditures with actuals throughout the fiscal year, providing monthly updated data for cash management.

Elements of best practice for month-to-month forecasting models include:

- **Revenue** f**orecast**. Variance between actual and forecast revenue needs to be managed.
- **Contractor payments forecast**. Contractor payments form the largest portion of cash payments throughout the fiscal year. Most states have developed contractor "payout curves" by project type, size, and duration based on statistical analysis of historical data on construction projects.
- **Forecasts of other expenditures**. Other expenditures such as payroll and transfers out are normally budgeted by month and therefore fairly predictable. This is also true for contract maintenance and other non-Six-Year Highway Plan contractor costs.

The Cabinet approach follows these best practices.

- **There are opportunities to strengthen the cash management approach by:**
  - Enhancing and refining project delivery management.
  - Establishing and managing to an acceptable level of risk.
  - Providing the Chief Financial Officer[14] (or equivalent) with approval authority over Authorization Review Team decisions.

Enhancing and refining project delivery management. Once a construction project is let there is a high degree of predictability regarding expenditures. However, the key area affecting the accuracy of expenditure forecasts out beyond 6 to 9 months will be the stability and accuracy of the letting schedule. Therefore, cash can be managed more effectively where there is greater management control and predictability regarding preconstruction project delivery. The section of this report that addresses project delivery identifies the need for continued improvement to project delivery management.

Establishing and managing to an acceptable level of risk. Best practice requires establishing, based on a risk analysis, the minimum cash balances that the Cabinet will manage the program against. The level of risk should be set as a matter of policy by executive management. To date, the Cabinet has not defined this level of risk.

Executive management should approach cash management as an exercise in balancing risks and returns. Cash balances should be minimized, subject to an acceptable level of risk. A cash balance or "cash on hand" is, in business terms, a bad thing. Resources that could otherwise be put to work in the

[14] The organization and management section recommends that, as part of the organizational realignment, a Chief Financial Officer be established.

organization's business are tied up in cash balances. The goal of cash management is to minimize the amount of cash on hand without threatening the business. The threat to the business is a lack of liquidity: an inability to pay bills and meet other obligations.

Setting a cash management goal of minimizing balances starts from the premise that the organization is not in the business of investing money to make money. The principal reason that this applies to the Cabinet, as it would to most government programs, is that taxpayers generally put a higher value on the services delivered by their government than they put on the investment income that the government might earn with their taxes. Otherwise, they would have voted to reject the taxes and the government services offered through them, and would have invested the funds to their own direct benefit. In the case of the Highway Fund, it was enacted to address specified needs and the implication is that the policy objective is to spend the resources and have the lowest possible cash balance.

Based on these assumptions, the Cabinet's cash management goal would be to minimize the cash balances in the Highway Fund, but always be able to pay their bills. In the absence of any risks to their ability to pay bills, which is discussed in the next section, the ideal cash balances in those funds would be $0. This translates into good public policy in the case of the Cabinet: the goal minimizes the interval of time between funds being taken from the taxpayer and the benefit (in the form of highway improvements) being returned to the taxpayer.

With this goal, the focus of the Cabinet's overall financial management is the management of risk. In the case of the Cabinet, the risk is the lack of sufficient liquidity to pay bills as they are submitted by highway construction contractors. In this way, the management of cash is the management of risk.

- **The risks can never be reduced to "zero."**

  The cash management goal is stated in terms of "minimizing the probability of having to borrow." The reason why that probability can never be reduced to zero is that current cash balances are held to fund future events, and future events can never be known with absolute certainty. When treasury managers say the probability of an occurrence is "zero," they often mean "not significantly different than zero." That phrase has a specific definition in probability theory which means that, however infrequently it might occur, no cash balance can assure that Cabinet project managers will never have to tell a contractor that they have to delay payment on an invoice.

- **Setting the "acceptable level of risk" is an executive management decision.**

  Given that risk can never be eliminated, but must be managed on an ongoing basis, someone in the organization must decide what constitutes an acceptable level of

risk. It is undoubtedly the toughest decision to be made around financial management and, since the implications of error can be drastic, good organizations treat this as a strategic decision to be made at the highest executive level.

The "acceptable level of risk" is a function of:

- The probability of an adverse event occurring.
- The consequences of an adverse event on the organization's core business.
- The ability of the organization to absorb or mitigate the consequences.

D. Recommendations

1. Recommendation IV-1: Produce a new cash feasible and financially constrained Six-Year Highway Plan.

The intent of this recommendation is that the current over programming be addressed by updating the Six-Year Highway Plan with a new fiscally constrained plan. The approach recommended is to establish buy in among the key stakeholders that the Cabinet should establish a new approach to planning, programming, and project prioritization that reflects best practice and implements the recommendations made in Section III for programming and project selection. Then with this buy-in on overall direction, an interim approach should be worked through whereby policy and system level considerations are used to apply a fiscal constraint to the current program.

This approach would involve the following steps:

- Establish overall policy priorities for the program. These would clearly need to balance the Governor's and the General Assembly's objectives.
- The policies would then guide establishing broad categories for projects.
- The projects in the Six-Year Highway Plan would be grouped against the categories.
- A financial constraint would be applied by determining policy-driven priorities for the relative allocation of the funds between the categories of projects.
- The available funding would then be assigned to the categories accounting for any federal restrictions regarding project eligibility. It is at this point that the consideration of federal funds management tools such as the use of Toll Credits that the Cabinet is proposing should be considered.
- Within the categories of projects an agreed approach to prioritization would be established and applied.

- The result of this approach would be that in some categories most projects would fall into a new Six-Year Highway Plan. In other categories, many projects could not be funded over six years.
- The projects not included in the new Six-Year Highway Plan would be recognized in a new element – a long-range program listing that includes prior approved projects. They would be then subject to reprioritization and eligible for inclusion as part of future Six-Year Highway Plan Updates.
- Within this framework, the use of debt authority would be evaluated applying the guiding principles recommended in this report. For example, if a portion of the current state program project will reduce the life cycle costs, then debt should be used. Or debt for specific large capital projects should be included within the updated program.

The outcome from this approach would be a Six-Year Highway Plan that can be delivered. The Cabinet would then apply the appropriate level of program and project management control over scope, schedule, and budget to provide accountability for the delivery of the program. There would be stakeholder buy-in that the new Six-Year Highway Plan will drive the biennial budget cycle. The Cabinet will strengthen its technical capability for explaining and communicating to policymakers and other stakeholders the implications of the budget decisions affecting the program to support the development of the new program and support subsequent updates.

2. Recommendation IV-2: Use debt-finance selectively, borrowing is not a solution to over programming in the Six-Year Highway Plan.

Our analysis indicates that it is unlikely that borrowing could address a large portion of the $1.94 billion shortfall. Borrowing would not allow additional debt capacity for Kentucky's other programs. Therefore, we recommend the following general principles with respect to debt financing for the highway program:

- The use of debt is an important part of the Cabinet's financial management but should only be considered for those projects:
  - That are unusually large and whose cash flow requirements would require so much revenue from other projects within the highway program that it would be disruptive to the overall program.
  - Where borrowing will yield tangible and realizable financial savings, such as reductions in maintenance or rehabilitation expenditures that are expected to exceed the cost of interest. In other words, the project has a viable business case. The key to identifying this set of projects is that cost savings must be tangible, realizable, and financial: in other words, there must be an identifiable impact on the Road Fund budget, either reducing expenditures or enhancing revenues. For example, economic benefits, even if they translate to indirect taxes, cannot be counted if they cannot be captured by the Road Fund.

3. Recommendation IV-3: Strengthen the Cash Management Plan by Setting Risk Based Cash Targets and establishing associated controls.

This recommendation involves performing a risk assessment by developing a statistical model to estimate the patterns of change in revenues and expenditures and then, using those patterns, to estimate the probability of different magnitudes of change in revenues or expenditures.[15] The risk analysis should account for the ability to borrow overnight on a short time basis. All major sources of uncertainties or risk, such as federal reauthorization, should be factored into the analysis.

This risk assessment would then be used to establish a Cabinet target financial risk management. In the process of assessing financial risks, senior management would identify the sources of risk, or what adverse events could ensue from the conduct of the organization's business. The Cabinet estimates the chances of those adverse events occurring and what impact their occurrence would have. Then senior management examines the options for absorbing the consequences of adverse events. Choosing one or more of these options sets the strategy for absorbing risks in the Cabinet's business.

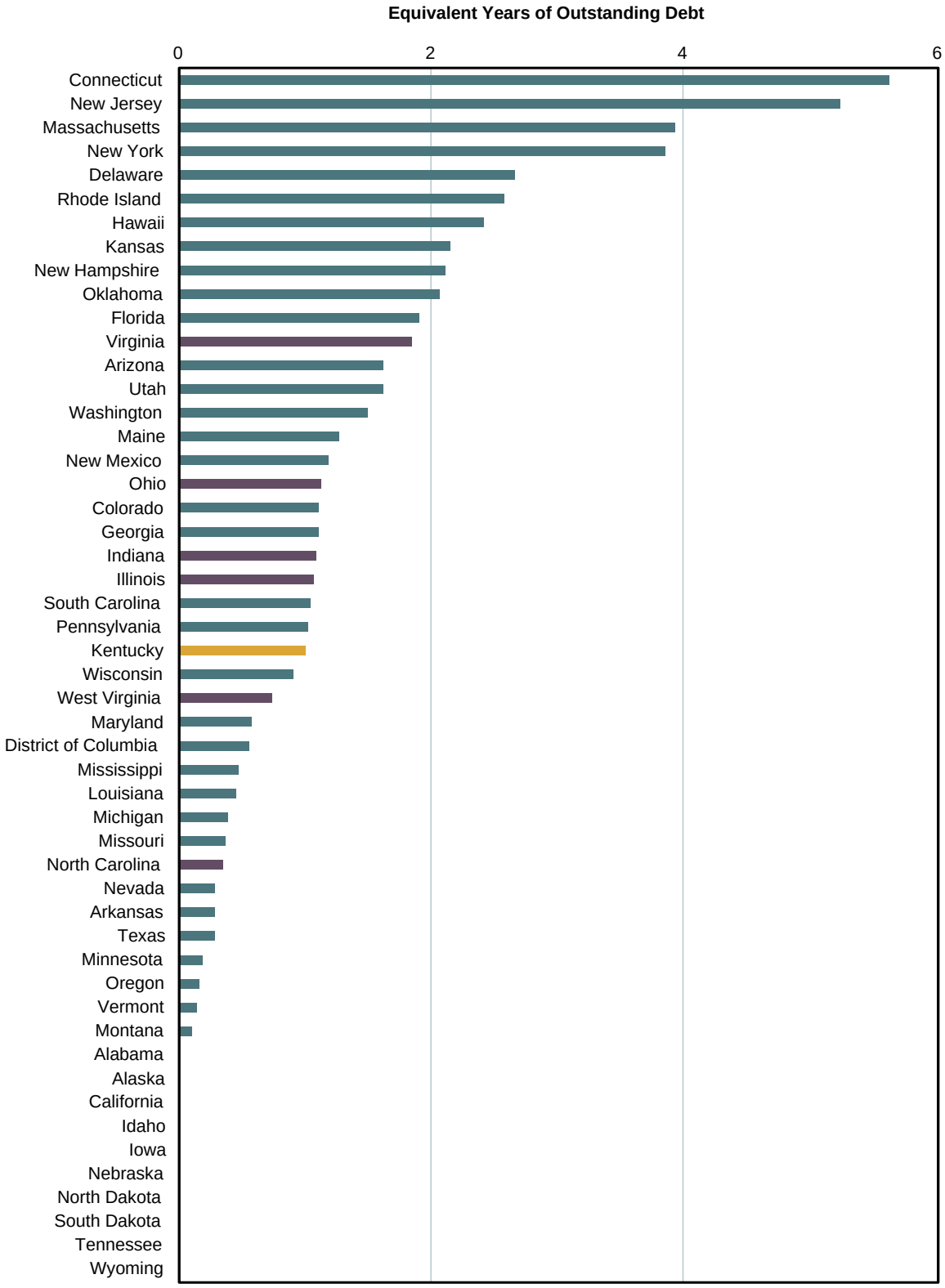
4. Recommendation IV-4: Broaden the role of the Authorization Review Team to a Cabinetwide Financial Planning Committee.

The intent of the recommendation is to ensure that the Authorization Review Team specified in the Cash Management Spending Plan[16] is established with an appropriate level of delegated authority to perform active cash management. The recommendation would formally establish this Committee as the cross-functional senior management committee through which strategic decisions affecting the cash position of the Cabinet are made.

[15] Those probabilities of changes can be used as margins of error around any forecast of revenues or expenditures and they can also be used to generate forecasts themselves. These models would then be used to determine empirically based target cash balances for the Kentucky Transportation Cabinet. The approach that Dye Management Group, Inc. has used is a time series analysis of revenues and expenditures and a frequency distribution analysis of payments.

[16] Kentucky Transportation Cabinet, September 29, 2003.

Exhibit IV-11: "Equivalent Years" of Outstanding Debt in all 50 States and District of Columbia, Excluding Toll Road and Transit Debt



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V. Preconstruction and Project Management

The preconstruction phase at the Kentucky Transportation Cabinet is described in this section. Preconstruction includes all the design, environmental, and right of way work necessary to bid out and build a project. Preconstruction is treated in the same section as project management because adhering to scope[1], schedule, and budget is particularly critical in the preconstruction phase. Preconstruction entails the coordinated efforts of many individuals in the preparation of plans, specifications, and estimates that may be hundreds of pages long. In comparison with the construction phase, in which terms and relationships are contractually based, the preconstruction phase generally involves more fluid relationships and task responsibilities.

This section begins with a general discussion of preconstruction, then links preconstruction and project management. The specifics of the Cabinet's organization and business practices are next described along with the Cabinet's efforts since the Empower Kentucky Project Delivery Redesign of 1996 and an analysis of its implementation.

This section answers two questions:

- **Question 1:** How effective is the Transportation Cabinet in delivering its Six-Year Highway Plans within scope, schedule, and budget?
- **Question 2:** How does the Transportation Cabinet compare to best practices for managing project delivery from project inception through bid letting?

A. Background

1. Where does preconstruction fit in the overall process of project delivery?

Preconstruction is the second of four primary phases of project delivery:

- Planning and programming
- Preconstruction
- Construction
- Maintenance and operations

Once a project has been programmed and authorized, it proceeds to the preconstruction phase. At the Cabinet, preconstruction functions, including design, environmental, right

[1] Project scope refers to the purpose of the project and the desired outcome.

of way, and utilities relocation, are managed and executed by the Office of Project Development. The basic organizational structure of the Central Office is carried through to the districts. That is, each district has design, environmental, and right of way staff, who report to a Preconstruction Branch Manager.

Preconstruction is the most technically complex phase of project delivery. Not only does it require high levels of skill and knowledge in multiple branches of civil engineering, it also requires extensive, ongoing coordination with professionals from other technical disciplines. To provide some perspective on the complexity of preconstruction, consider the following Exhibit V-1, which lists only some of the tasks involved in the preconstruction phase of a major transportation improvement, and at a very high level. In fact, on large projects, some of these rolled up tasks may require hundreds of person hours.

Exhibit V-1: Tasks Involved in the Preconstruction Phase of a Major Transportation Improvement Project

• Obtain aerial mapping. • Obtain field surveys. • Request turning movements for intersections. • Request preliminary studies for predesign meeting. • Request preliminary environmental review. • Identify wetlands, underground storage tanks, and permit requirements. • Request utility locations. • Prepare preliminary horizontal alignment. • Prepare continuous profiles and critical sections. • Hold preliminary line and grade inspections.	• Obtain approval of environmental action. • Request geotechnical study. • Advertise and hold public hearings. • Obtain and advertise location approval (federal only). • Begin final design of construction plans. • Obtain permits. • Hold drainage inspection. • Develop drainage plans. • Request updated estimates for right of way and utilities. • Submit right of way plans. • Submit utilities plans. • Submit inspection report, environmental checklist, and Design Executive Summary.

Once Preconstruction has completed the plans, specifications, and estimates, Contract Procurement prepares the project for bid letting, advertises the proposal, receives the bids, and, in conjunction with an Award Committee, decides whether to accept, reject, defer, or rebid the project.

2. The Importance of Project Management in Preconstruction

Whereas other phases of project delivery, such as planning and construction management, are centered around a limited number of players from one discipline, or a handful of disciplines, preconstruction brings together the efforts of disparate individuals and groups to produce a single set of plans, specifications, and estimates. Keeping a team of 10, 15, or more professionals from at least four disciplines working toward a single goal with a single budget and schedule is no small feat, particularly

where there are competing demands on team members' time. Therefore, the question soon arises: "Who is coordinating the overall process to ensure that critical path items are identified, that activities proceed in the most efficient sequence, and that the project's overall schedule and budget will be met?" Increasingly, the answer at transportation agencies nationwide is a newly defined function, that of project manager.

Nationwide, transportation agencies' growing interest in project management is driven by the pressures to be accountable for delivering overall programs of projects and services. Moreover, accountability in delivery has come to mean ongoing appraisals of measurable outcomes at both project and program levels.

3. Kentucky Transportation Cabinet's Preconstruction and Project Management Practices

The preconstruction process at the Cabinet begins when a project is programmed into the Six-Year Highway Plan and then authorized, at which point it reaches the district. Once it reaches this point, the Preconstruction Branch Manager generally reviews the staff workload and the project itself to make a decision as to whether to complete the project in-house using Cabinet staff or to outsource all or portions of the project to consultants (consultants currently perform about 60 percent of the Cabinet's design work). Districts may outsource projects in part or in their entirety because of the need for specialized expertise or because the project load simply outstrips the availability of in-house resources.

Whether the project is completed in-house or by a design consultant, a Cabinet project manager is assigned to oversee the work. Virtually all of the Cabinet's project managers come from the design area of preconstruction (as opposed to environmental or right of way). With very few exceptions (notably District 12), the Cabinet's project managers wear "two hats." That is, they manage projects, but they also perform actual design work.

a. Kentucky Transportation Cabinet's project management approach.

Project managers at the Cabinet are almost always members of the design staff within the districts who have been designated as project managers by the districts' preconstruction engineers.

The project scope, schedule, and budget are typically defined with the Six-Year Highway Plan. It is to these parameters that the project manager is attempting to manage.

Project managers are required to update their estimates of construction cost and letting date at specified project milestones that run throughout the preconstruction process. These milestones include the following:

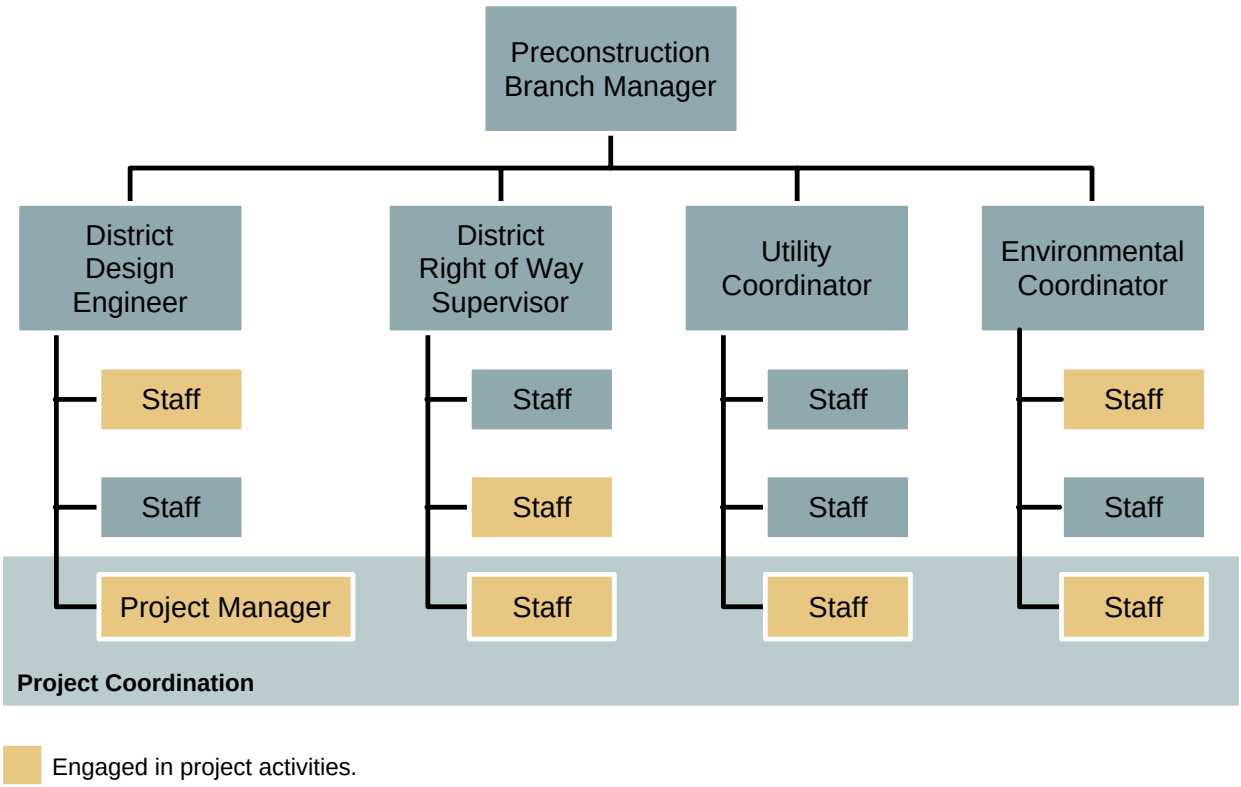
- The Predesign Meeting, which convenes for the first time to flesh out the project scope and establish roles and responsibilities.
- The Range of Alternatives Meeting.
- The Scope of Impacts Meeting, which is an opportunity for design and environmental staff to consider the chosen alternatives' impacts in terms of opportunities to work on both design and environmental tasks concurrently.
- The Final Design Meeting, at which point design is approximately 90 percent complete and the District and Central Office staff complete their joint inspection of the work.

Project managers at the Cabinet are not responsible for managing the budget of preconstruction work; rather, they are currently only required to manage expected right of way, utilities, and construction cost. In terms of schedule, they are managing to the planned letting date. Although the Office of Project Development is working toward the capacity to actively manage preconstruction costs, the Cabinet's information systems do not support this well enough to make it practical at this time.

In terms of program-level oversight of project management, the cost and schedule status updates that project managers must complete at set milestones are used to alert management to deviations from the Six-Year Highway Plan as they pertain to estimated right of way, utilities, and construction costs. In addition, any scope change that would affect project cost or letting date must be approved by an Assistant State Engineer.

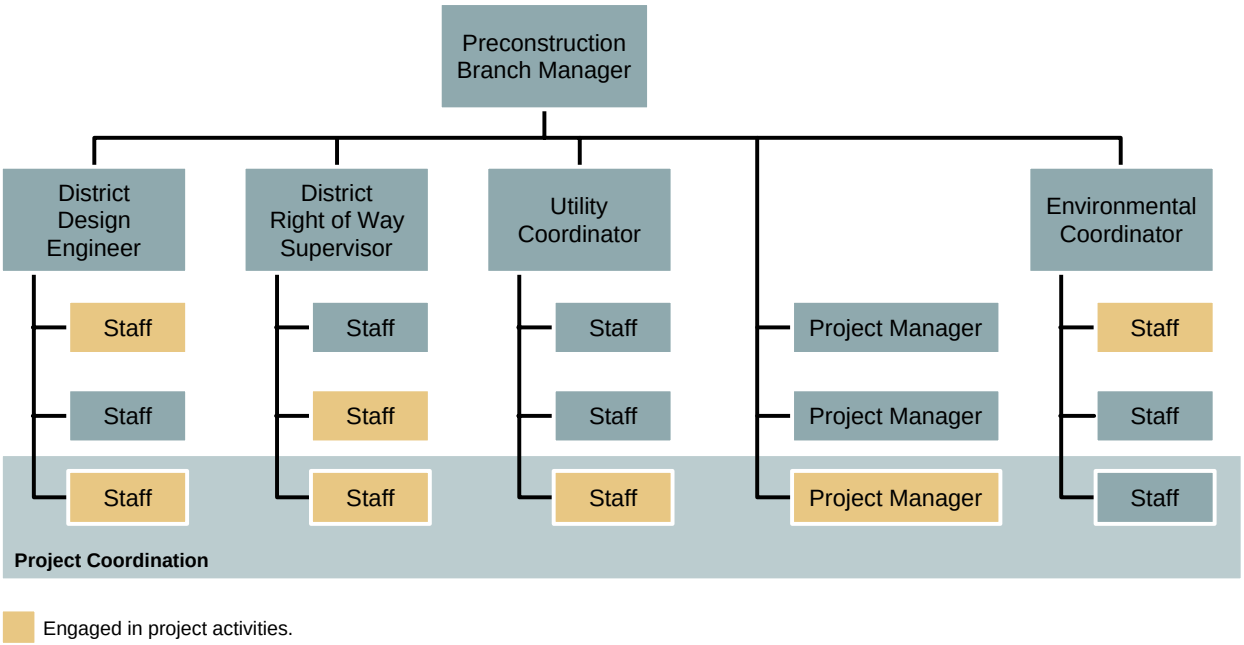
The prevailing way to characterize approaches to project management is to distinguish between "weak matrix" management at one end of a spectrum, and "strong matrix" management at the other. A weak matrix structure for project management is one in which staff from different technical functions come together to deliver a project as a team. While a staff person from one of the functional disciplines (e.g., design, environmental, or right of way) is designated project manager, his or her role is more one of coordination than authority. Moreover, in weak matrices, the project manager takes on that coordination role in addition to his or her primary job as a technical specialist. A weak matrix approach to project management is depicted in Exhibit V-2.

Exhibit V-2: A Weak Matrix Project Management Model



A strong matrix approach is one in which multidisciplinary teams work together to complete a project under a dedicated project manager, for whom project management is his or her primary focus. Under strong matrices, project managers generally report to a manager of project managers or at a level equal to that of the functional managers. A strong matrix management approach is depicted in Exhibit V-3.

Exhibit V-3: A Strong Matrix Project Management Model



Most districts approach project management from a weak matrix perspective (a notable exception is District 12, which has several dedicated project managers). The characterization "weak" is not pejorative. In fact, a weak matrix may be the most appropriate approach to project management in districts with relatively small and highly variable workloads. However, the Office of Project Development has spearheaded several initiatives within the past several years aimed at strengthening the role of the project manager as a means of increasing accountability Cabinetwide. These initiatives include the establishment of a Project Manager's Academy and software improvements, detailed later in this section.

b. Schedule and budget control.

The Preconstruction staff interviewed in both the Central Office and in the districts concurred that, prior to the development of the Oracle-based, Six-Year Highway Plan Project Status Report, they had little ability to track their projects in terms of either schedule or cost. Even so, as it is currently configured, the system functions more as a control mechanism for Six-Year Highway Plan accounting than as a project management tool. The Six-Year Highway Plan Project Status Report is limited in its utility for project management purposes because it lacks financial detail of project charges. In the recent past, the emphasis within the Cabinet was on getting the project to its scheduled letting date with little direct management or accountability for budget or scope. Now there is emphasis on managing both schedule and cash flow.

c. Project management training and development at the Kentucky Transportation Cabinet.

Until very recently, project management skills and procedures were passed on informally at the Cabinet. This informality is reflected in the lack of documentation on the project delivery process as a whole. Although the Cabinet has separate manuals (most outdated) devoted to separate technical functions (e.g., design and right of way), these contain little or no guidance on how the various technical functions should be integrated to complete a project in a timely and cost-effective manner. Many other states, including Colorado, Utah, and Oregon, offer separate project delivery manuals that guide project managers through every stage of project delivery, clearly laying out the respective players' roles and responsibilities, the procedures they should follow, and where they can go for help.

However, the Office of Project Development has been working over the past several years to support project management by offering training and improving management software tools. By empowering project managers, the Cabinet is moving toward a stronger form of matrix management. These training and software tools are described below.

- **Project Managers Academy**. The Kentucky Transportation Cabinet Office of Project Development has teamed with the Kentucky Transportation Center at the University of Kentucky to develop an eight-day course devoted to project management approaches, skills, and practices. The August 2003 inaugural course was presented by Cabinet leaders to an audience of Central Office and District employees. The curriculum is expected to evolve, and there are plans to offer the training to a much broader audience.
- **Project management software improvements**. The Office of Project Development has been working over the past several years to build into the Oracle-based, Six-Year Highway Plan system improved tracking of project cost and schedule. Though the primary purpose of this effort is to manage the Six-Year Highway Plan from a program perspective, this system also provides project managers with a somewhat crude budget and schedule tracking tool. Section IX, "Project Management Information Reporting Capabilities," provides a detailed assessment of the information systems supporting project delivery management.

B. Question 1: How effective is the Transportation Cabinet in delivering its Six-Year Highway Plans within scope, schedule, and budget?

1. Answer

There were significant challenges in establishing a data set from which to perform a quantitative evaluation of the extent to which Six-Year Highway Plan projects are delivered within the scope, schedule, and budget that were initially set. Analyzing projects that were let within the past two fiscal years, the quantitative analysis finds that projects are being delivered through preconstruction on a timely schedule. However, it was not possible to evaluate whether projects were delivered within their planned time frame. Preconstruction budgets were exceeded; it appears that considerably more is being expended on preconstruction than was planned for. In aggregate, using the estimated construction cost as an indicator of scope, scope is being well managed; however, there is substantial variation between projects.

2. Analysis Approach

The following approach was taken:

- A data set was established to analyze all projects let within the last two fiscal years.
- Budget was evaluated by analyzing design authorization compared to design expenditure. Design expenditure included all charges to the design phase whether for Cabinet staff or consultants.
- Project schedule was measured by evaluating the design time. However, there was not a systematic way to evaluate how long design took compared to when it was originally planned to be completed.
- Project scope management was measured by comparing the engineer's estimate and the award amount to the first time a construction estimate was recorded against the project in the Six-Year Highway Plan.

3. Findings

- **Project Schedule**

  The MARS system reports the first time an authorization was made for each phase (design, right of way, and utilities). It was not possible to determine how long each of these phases took to complete. It was explained that completion dates for each phase are not recorded. An alternative way to assess preconstruction schedule is to measure the total time required to complete design, right of way, and utilities. This can be achieved by comparing the date when the first phase began against the letting date.

– **Design work has been completed on a timely schedule.**

Exhibit V-4 shows the average time from design authorization to project letting by work type and by the construction awarded amount. Although systematic benchmarking data is not available from neighboring states, the Cabinet's performance compares favorably to other states.[2] What this analysis does not address is project and program management performance. That would be measured by determining how long it took to deliver the project by comparing the actual let date against the date the Cabinet first committed to deliver the project.

Exhibit V-4: Preconstruction Average Time from Design Authorization to Let Date

Type of Work and Construction Amount	Number of Projects	Average Time (years)
Road Reconstruction/Modernization		
< $1,000,000	51	2.14
1,000,000 – 5,000,000	35	4.24
5,000,000 – 15,000,000	35	4.92
15,000,000 >	10	5.33
Bridge Reconstruction/Modernization		
< 1,000,000	50	3.45
1,000,000 – 5,000,000	18	4.41
5,000,000 – 15,000,000	7	6.23
15,000,000 >	4	3.47
Pavement Preservation		
< 1,000,000	1	0.10
1,000,000 – 5,000,000	6	6.68
5,000,000 – 15,000,000	3	1.34
15,000,000 >	3	0.99
Bridge Preservation		
< 1,000,000	1	3.77
1,000,000 – 5,000,000	N/A	N/A
5,000,000 – 15,000,000	N/A	N/A
15,000,000 >	N/A	N/A
Other		
< 1,000,000	24	0.80
1,000,000 – 5,000,000	3	0.91
5,000,000 – 15,000,000	N/A	N/A
15,000,000 >	N/A	N/A
Total	**502**	**1.7**

Source: MARS and Six-year Highway Plan System.

[2] Based on sampling of other states delivery times reviewed by Dye Management Group, Inc. as part of other engagements.

For most type of projects the time required to complete the preconstruction process is correlated to the project's construction award amount. The larger the award amount, the longer it should take for the preconstruction process to be completed.

In the pavement preservation category, the time required to complete the preconstruction process was actually greater for smaller size projects. Typically, for pavement preservation projects, right of way, and utility are not involved. This leaves design as the only component to drive costs. The fact that design costs more on smaller size projects might be explained by the use of consultants for smaller projects and in-house design for bigger projects.

Schedule performance is currently not being managed by the Cabinet. Tracking start and end dates for each of the projects would allow the Cabinet to identify and document the cause of schedule slippage. It also would allow the Cabinet to set standards for performance in the preconstruction process.

- **Project Budget**

The Cabinet does not have an explicit practice of establishing a preconstruction budget and then holding project managers accountable for it. A preconstruction budget would include all the costs for developing a project so that it can be let.

Data on actual expenditures for each of the preconstruction phases are available through the MARS system and the authorization amount by project was used as a budget amount to compare performance against. For each project, these two values were computed and then analyzed by district and work type. Exhibit V-5 show the results.

– **Design expenditures were some $15 million greater than design authorization.**

For the sample of 187 projects, the budgets for the design phase were $15 million or 40 percent greater than the actual expenditures as shown in Exhibit V-5. Major bridge work contributed the most to this increase as shown in Exhibit V-6. These results show a significant under budgeting of the design phase. This issue was brought up to the Cabinet management. It was explained that it is common practice to assume during the budgeting process that design will be performed in-house, but it may ultimately be done by private consultants, significantly increasing the cost. This seems to be especially true in the case of bridge reconstruction and modernization, which explains the significant cost increase.

Exhibit V-5: Design Authorization Compared to Design Expenditure, Projects Let in Fiscal Years 2002 and 2003

	Design Expenditures		
District	**Authorized ($)**	**Actual ($)**	**Variance (%)**
1	1,155,901	1,766,485	53
2	1,821,514	2,422,670	33
3	530,000	845,296	59
4	3,794,714	5,043,960	33
5	5,212,440	9,781,737	88
6	4,456,250	6,958,798	56
7	4,691,000	8,175,347	74
8	1,429,000	1,705,758	19
9	5,272,368	6,182,109	17
10	2,235,907	2,767,630	24
11	2,477,411	2,905,803	17
12	5,368,500	5,140,742	-4
Total	**$38,445,005**	**$53,696,337**	**40%**

Source: Sample of 187 projects with available data.

Exhibit V-6: Design Authorization Compared to Design Expenditure by Major Work Type, Project Let in Fiscal Years 2002 and 2003

	Design Expenditures		
Type of Work	**Authorized ($)**	**Actual ($)**	**Variance (%)**
Highway Modernization	26,921,004	34,256,756	27
Bridge Modernization	9,014,001	17,625,195	96
Pavement Preservation	1,825,000	1,124,559	-38
Bridge Preservation	---	---	
Other	685,000	689,827	1
Total	**$38,445,005**	**$53,696,337**	**40%**

Source: Sample of 187 projects with available data.

- **Scope Management**

  The scope of a project is identified and a preliminary construction cost estimate based on this scope is generated in order to include a project in the Six-Year Highway Plan. A key project management concern is ensuring that the project designed is within the originally intended scope of the project as selected for

inclusion in the Six-Year Highway Plan. An industrywide issue is that projects change during design and the "scope creeps" so that construction costs increase and the project that is designed differs from that intended at the planning level.

Estimated cost to construct is used as an indicator of scope management. To assess construction estimate escalation during the preconstruction process, the first estimate for each project was compared to the available estimate before construction started. Projects were grouped by type of funding (state and federal) because for each type different points in time are used to compute cost estimation variance. The data set used included fiscal years 2001 through 2003.

Construction costs are estimated and recorded in the Six-Year Highway Plan system and used as a starting point to compare against the engineer's estimates. These data indicate that the project scope is well-managed. The increase in expected construction costs can be attributed to inflation, scope creep, inadequate initial estimate, or inadequate project definition. Care must be taken, however, in interpreting the data. The original estimates are established in advance of design, in some cases a number of years, and do not factor in inflation. In addition, the original estimates are not developed through a standardized process designed to increase their accuracy, and the nature of design is such that there are uncertainties affecting cost that can only be identified during design. Exhibit V-7 shows the increase in construction costs during design on federally funded projects.

The first estimate for state funded projects is usually the engineer's estimate. For these projects, the first money authorization is made after projects are let based on the lowest bid plus construction engineering (CE) costs. For state funded projects, construction estimate variance is computed using as starting point the engineer's estimate and final point authorization amount. Exhibit V-7 and Exhibit V-8 show the results of costs estimation variance.

Exhibit V-7: Increase in Construction Costs During Design, Federally Funded Projects, Escalation of Construction Cost During Design (Federally Funded)

Difference Between Initial Authorization and Engineer's Estimate	Number of Projects	Initial Authorization ($)	Engineer's Estimate ($)	Variance ($ M)	Variance (%)
Under Estimate	92	228,315,659	372,720,646	144	63.2
Within Estimate (+,-10%)	90	370,283,078	374,032,875	4	1.0
Over Estimate	59	521,325,195	348,765,789	(173)	-33.1
Total	**241**	**1,119,923,932**	**1,095,519,309**	**(24)**	**-2.2**

Exhibit V-8: Increase in Construction Costs During Design, Federally Funded Projects, Escalation of Construction Cost During Design (State Funded)

Scope Variance	Number of Projects	Engineer's Estimate ($)	Authorization Based on Low Bid ($)	Variance ($ M)	Variance (%)
Under Estimate	27	106,376,253	126,021,192	20	18.5
Within Estimate (+,-10%)	56	177,837,483	180,815,799	3	1.7
Over Scope Estimate	69	277,977,184	208,718,311	(69)	-24.9
Total	**152**	**562,190,919**	**515,555,302**	**(47)**	**-8.3**

In the case of federally funded projects, the number of projects let during the past two fiscal years represents only 25 percent of the projects let during this period but accounts for the greatest variance. This is evidence that larger projects are responsible for the cost escalation. In the case of state funded projects, we were not able to identify an earlier project estimate; therefore, it is not clear that we have a good measure for scope management.

Results from state funded projects support the findings from the bidding process. In highly competitive environment it would be natural for most, if not all, low bids to fall below the engineer's estimates. Results from the state funded projects show that in more than half of the cases low bids from projects exceeded engineer's estimates.

C. Question 2: How does the Transportation Cabinet compare to best practices for project delivery management from project inception through bid letting?

1. Answer

The Kentucky Transportation Cabinet is in the second tier of state departments of transportation in its organization and practices around project delivery. There are significant opportunities for improving the efficiency and effectiveness of project delivery through strengthening project management in preconstruction. This will result in significant cost savings, strengthen the Cabinet's cash management plan, and provide the controls necessary to improve accountability for delivering the Six-Year Highway Plan. The Cabinet has not reached the maturity of states such as Michigan, Minnesota, New Jersey, New Mexico, Utah, and Oregon (which are in the first and highest tier) in terms of having in place both processes and performance measures to ensure accountability for project delivery. For instance, the roles and responsibilities

for project management are unclear, there is no written documentation to guide the project delivery process, and the Cabinet has not established a consistent approach to project management.

The Cabinet's Offices of Program Planning and Management and Project Development have a longstanding recognition of the need for better project management controls and accountability. There now needs to be executive leadership to accomplish improvements in this business area.

2. Analytical Approach

Our analysis involved the following steps:

- Review of all internal Cabinet documentation pertaining to project delivery (e.g., *Design Manual*, *Right of Way Manual*, Blitz Team Reports, Design Memoranda, etc.).
- Interviews with project delivery staff and management from the Central Office and Districts 5, 7, 11, and 12.
- Comparison and contrast of findings from the Cabinet with Dye Management Group, Inc.'s knowledge of industry best practices, which is based on the firm's benchmarking experience nationwide.

3. Findings

- **Implementing improvements to the Project Delivery Process requires greater leadership priority from executive management.**

  To strengthen individual and departmentwide accountability for project delivery, management will require the active support of the agency's executive leadership. Best practices benchmarking consistently shows that clear, ongoing executive leadership is far and away the most important factor in shifting from the traditional sequential approach to a strong matrix approach.

  Because the shift to management by project may entail new, altered reporting relationships and resource allocations, commitment at the very top of the organization is vital. Management by project is often resisted by "old line" functional managers who have built their careers by directing functional groups. Such managers fear they would lose authority and status to newly empowered project managers under the strong matrix approach.

- **There are opportunities to strengthen project management capacity to ensure accountability for project delivery.**

  The lack of clarity of the respective roles and responsibility for project management between the Central Office and the districts dates back to 1996, when Governor

Patton announced a government streamlining effort called "Empower Kentucky." At the Cabinet, a Project Delivery Process Redesign was undertaken by a large internal task force with representation from both the Cabinet's Central Office and from the districts as part of the Empower Kentucky effort.

The primary recommendation in the Empower Kentucky Project Delivery Process Redesign was to decentralize project management responsibility to the districts. "Districts, not the Central Office, will have primary responsibility and the accountability for project delivery. [The] Central Office will monitor progress towards accomplishing the work scheduled in the Six-Year Highway Plan."

Direction for implementing the Project Delivery Process Redesign came in a January 1998 Design Memorandum (No. 4-98) from the Director of the Division of Highway Design addressed to Chief District Engineers, Active Consultants, and Design Engineers. As an implementation plan, it was very brief and did not contain enough specificity to explain what the decentralization would mean in practice. In short, the decentralization recommended in the Empower Kentucky Project Delivery Redesign was not fully implemented. As a result, areas of confusion with regard to the respective responsibilities of the Central Office and the districts were not fully resolved.

This came to light in January 2001, when the Office of Program Planning and Management convened a "Project Delivery Leadership Team," an internal quality improvement initiative that drew upon some 100 Cabinet leaders as well as FHWA liaisons. This group was divided into 13 "Blitz Teams" with 6 to 11 members apiece. The Blitz Teams concentrated their resources and attention for a short but focused period. Each Blitz Team wrote up its results with reference to each of the following:

- Existing processes and procedures.
- Unmet business needs.
- Barriers to effective positive change.
- Recommendations for improving the Cabinet's project delivery process component by component.

That the decentralization plan set forth in the 1996 Empower Kentucky Project Delivery Business Process Redesign had not in large part been implemented is clear in several of the Blitz Teams' reports, one of which said: "It is interesting to note that most of these issues were identified as major elements in the 1996 'Empower Kentucky Redesign of the Project Development Process'. It is evident that we are not 'running on all cylinders' because we have only partially implemented the Empower Kentucky Process in the Project Delivery Area." Three years after the Empower Kentucky Project Delivery Business Process Redesign was to have been implemented, the Project Management Blitz Team

pointed out a number of areas of ambiguity regarding roles, responsibilities, and accountability for project delivery:

- What exactly is the responsibility of the District Project Delivery Team?
- How much authority does a District Project Delivery Team have?
- Who participates and what is their responsibility?
- How is the project manager selected?
- Who appoints the project manager?
- Who does a project manager report to?
- What qualities should a project manager have?
- Does a project manager need to be trained, and, if so, what kind of training?
- What tools does a project manager need?

While the Cabinet has taken some steps to address these issues, our fact finding indicates that establishing unambiguous roles, responsibilities, and accountabilities at the Central Office and the districts with regard to project scope, schedule, and budget remains important for more efficient project delivery.

- **Despite the fact that the Cabinet is outsourcing more of its preconstruction work, the organization as a whole has not developed a strategy to manage the use of design consultants.**

  Decisions on which projects to keep in-house and which to outsource are being made on an ad hoc, district by district basis. It is important to establish consistent business practices that ensure that consultant work is completed on time, on budget, and with the required quality. Many project managers interviewed complained about poor quality consultant work and the consequent need to redo their work in-house. This is a complaint that we frequently hear in many state departments of transportation; however, closer examination usually finds that the issue is not poor performance across the board but poor performance on a few projects and the lack of effective management of design consultants by the client agency.

  Among other issues, it is important that in-house staff have the expertise to supervise consultants, which is not possible unless they have a real understanding of the project delivery process and roadway design.

- **Project managers have limited information with which to manage the scope, schedule, budget, and overall delivery status of the projects for which they are responsible.**

  In practice, project managers do not plan, execute, monitor, or control their budgets. Several project managers reported that they are responsible for as many

as 40 or 50 projects. Although not all of these projects are active at a given time, this load is high compared to the norm at other state departments of transportation of 10 to 20 projects.

D. Recommendations

Recommendations addressing improvements to information systems that will support project management are detailed in Section VIII.

1. Recommendation V-1: Strengthen project management as an executive priority.

The intent of this recommendation is that the Cabinet make strengthening project management a Cabinetwide strategic business improvement priority. Executive leadership is required because improvements to project management will cut across all districts and technical functions in the Central Office. The approach to implementation should involve the following overall approach:

- Establish and communicate leadership goals and objectives for project delivery and project management, specify how improvement progress will be measured, and make the results available to the public.
- Define roles, responsibilities, and accountability for project management, defining a standardized and agreed set of organizational roles and responsibilities. This is best accomplished through a task force within the Cabinet. Among the issues to resolve will be the most effective levels of centralization and decentralization for preconstruction. With 12 districts there is simply not the volume of work and there is a diseconomy of scale for many of the technical disciplines to be located in every district.
- Establish standardized business rules and accountability mechanisms for project scope, schedule, and budget management.
- Provide the tools to support project scope, schedule, and budget management.
- Establish a project manager position and career path. Project managers currently function within existing positions. Creating specific positions and career paths for project managers underscores the organization's commitment to management by project, facilitates project manager selection by articulating the skills and knowledge specific to project management, and allows performance criteria to be tailored to tie project outcomes to employee evaluation.
- Redeploy some of the positions in the State Highway Engineer's Office (now serving as district liaisons) as dedicated project managers stationed in the districts. The benefits would be two-fold: it would provide additional resources to project managers in the districts and reduce Central Office redundancy. Typical duties for dedicated project manager positions include facilitating,

coordinating, and managing design projects; establishing and maintaining project scope, schedule, budget, and quality; preparing and administering consultant contracts and agreements with local governments and agencies; serving as the focal point for all public and agency relations; and providing and communicating project progress and data.

2. Recommendation V-2: Designate a single "champion" for project management Cabinetwide as part of the organizational realignment recommended in Section II.

The intent of this central focal point is advocacy – to create a visible presence and source of support for project managers on a footing equal to that of functional managers. Currently the most logical place for this function to reside would be the Office of Project Development. This champion would be the central source of information and support for project managers, including training, guidance, coaching, providing materials, and other forms of support. The function will own project management as a professional discipline in its own right within the Cabinet.

3. Recommendation V-3: Establish consistent project management procedures and codify in ongoing training and written reference materials.

Regardless of the level of authority that the Cabinet ultimately establishes for project managers through either the implementation of Recommendation I-1 above, or the current business direction, it is important that a core set of standardized requirements and procedures for managing any project be established. These include well specified roles and responsibilities for the many entities that are responsible for project delivery at the Cabinet. Consistent processes required for establishing and managing each of the following would be part of this effort:

- Project scope
- Project schedule
- Project budget
- Project quality

The Cabinet has begun to offer project management training, a positive step. However, this training should be updated and expanded to reflect any work that the Cabinet does to establish consistent project management procedures. In addition, it is recommended that an accurate, up-to-date Project Delivery Manual be written and maintained. This documentation should specify clearly who is responsible for what at each point of project delivery. This includes technical tasks, relations with the public and with other agencies, reviews and approvals, dispute resolution, and project management.

Although the agency has a Design Manual, it is out of date and does not address coordination between design and the other functions.

4. Recommendation V-4: Establish standardized policies and practices for determining when and how preconstruction work is outsourced and managed.

A critical project management skill is project resource management – specifically, the management of contracted resources. This recommendation will establish general policies on which projects to perform in-house and which to outsource. It would also include a set of business procedures designed to improve the management of consultants. The purpose of developing such an approach would be to improve the quality and consistency of consultant products and to ensure that project managers and other Cabinet staff have the required skills to effectively supervise consultants.

VI. Construction Procurement

This section addresses construction procurement. Construction procurement is materially one of the most significant business areas to evaluate for improvement opportunities because it accounts for a high proportion of the Cabinet's budget. In fiscal year 2002-2003, some $697 million was expended on construction. Therefore, because of the large dollar value of construction, a small percentage reduction in costs can increase the productivity of the program and enable the Cabinet to fund more projects.

The questions evaluated are:

- **Question 1:** Is the Commonwealth of Kentucky getting a competitive price through construction procurement?
- **Question 2:** Are incentive and disincentive provisions being used effectively?
  - Are the level and types of incentives comparable to those of other states?
- **Question 3:** Is the Commonwealth of Kentucky making use of innovative and non-traditional contracting approaches?

A. Background

Construction builds projects according to the plans and specifications defined during preconstruction (design). The Cabinet's highway construction projects include: Six-Year Highway Plan projects, contract maintenance, and other highway improvements.

- **Construction procurement**. Since all construction work is contracted, the vast majority of expenditures are contractor payments. The Cabinet awards highway construction contracts to the lowest responsive bidder, as required by KRS176.080.[1] Public construction procurement based on the lowest price reflects social values regarding public administration such as transparency, fairness, ease of contract administration, and competitive bidding. The low bid selection method is simple: the bidder who offers the lowest construction prices is selected as the contractor. Prospective bidders are prequalified. The prequalification process requires contractors to obtain a performance bond in the amount of the contract in order for the Cabinet to execute the contract.

[1] Unresponsive bids are those that fail to meet all bidding requirements and thus are ineligible for consideration or selection. Such failures may include omission of a bid price for each item, omission of a non-collusion affidavit, and failure to submit a bid bond, among others.

The Cabinet has a documented set of business rules governing construction procurement. These rules ensure that Kentucky meets federal requirements for federally funded work and complies with state law. The process involves the following steps:

- An engineer's estimate is prepared after the preconstruction team has completed its primary deliverable, the package comprising 100 percent of the project design and specifications.
- Projects are to be advertised at least 21 days in advance of bid openings for a federally funded project and 7 days for a state funded project.
- The engineer's estimate is not disclosed to the construction industry.
- Bids are evaluated and contracts awarded. Typically states have well defined business rules governing how bids are reviewed in relation to the engineer's estimate as part of a bid evaluation process.

In many state departments of transportation, a separate division prepares the engineer's estimate and often conducts market analysis. The purpose of the market analysis is to help develop better engineers' estimates and provide input to construction procurement to reduce costs and increase competition.

- **Engineer's estimate**. The engineer's estimate is the first and one of the most critical steps in managing procurement because this estimate is the basis for comparing contractors' bids. Continuously attending to the accuracy and nondisclosure of the engineer's estimate is critical in providing citizens of the Commonwealth the best value for their dollars through a competitive procurement in which everyone has equal access to the information. Further, in an environment where there are large numbers of projects that receive only one bid, nondisclosure of the engineer's estimate is extremely important.

  If the engineer's estimate is too high, then the Commonwealth runs the likelihood of overpaying for a project. If the engineer's estimate is disclosed to some bidders and not others, then the selection process is corrupted.

  The Federal Highway Administration tightened its controls on estimating procedures and bid collusion analysis nationwide due to bid rigging scandals during the 1980s. The Federal Highway Administration has set forth guidance for the preparation of engineers' estimates in its Contract Administration Core Curriculum Participant's Manual and Reference Guide 2001.[2]

  There are three basic approaches to preparation of the engineer's estimate:

  - **Historical Data Approach**. The use of data from recently awarded contracts is the most common approach. Under this approach, bid data are summarized and

[2] Available: http://www.fhwa.dot.gov/programadmin/contracts/cor_IIIA.htm.

adjusted for project conditions (i.e., project location, size, etc.) and the general market conditions.

- **The Actual Cost Approach**. This takes into consideration factors related to actual performance of the work including: the cost of labor, equipment and materials; sequence of operations; production rates; and a reasonable value of overhead and profit from the ground up.

- **The Hybrid Approach**. This combines the use of historical bid data with actual cost development. Most projects contain a small number of items that together comprise a significant portion of the total cost. These major contract items may include Portland cement concrete pavement, structural concrete, and structural steel and can amount to 70 percent of a project's cost. Prices for these items are estimated based on historical prices and adjusted as appropriate for the specific project.

Exhibit VI-1: Approaches o Developing the Engineer's Estimate

Estimating Approach	Advantages	Disadvantages
Historical Data Approach	Requires the least amount of time and personnel to develop and produce a good estimate as long as noncompetitive bid prices are excluded from the database and then accounted for.	Most susceptible to outside factors such as inflated bid prices from contracts with little or no competition.
Actual Cost Approach	While adjustments for current market conditions may be required, this approach typically produces an accurate estimate. Particularly useful in estimating unique work where there is insufficient bid history.	Requires the estimator to have a current working knowledge of construction methods and equipment.
Hybrid Approach	Prices for those items that make up a large majority of the project are based on actual costs, which reduce the chances for percentage error.	Basing other prices on historical data may lead to inaccurate results in this portion of the estimate when these items have been previously bid in an uncompetitive environment.

- **Engineer's estimate confidentiality**. Kentucky, along with the 11 other states, never discloses the engineer's estimate in advance to prevent bidders from knowing the approximate amount the agency is willing to pay for the project. Practices vary among states. Some disclose the amount up front (4 states, including Texas), some publish an estimated cost range (6 states), and some (11 states) disclose the estimate upon contract award.[3] Knowledge of the estimate would give a strong advantage to any

[3] Primer on Contracting for the Twenty-First Century: A Report of the Contract Administration Task Force of the AASHTO Subcommittee on Contracting, Fourth Edition 2001.

bidder who secretly procured it, which can put pressure on agency employees to secretly release the estimate. This information would be very beneficial in a one-bidder environment or in a very competitive environment because firms could use the information to manipulate their bids.

- **Construction incentives and disincentives**. Within the statutory requirements governing construction procurement, the Cabinet can include incentive/disincentive provisions for early contract completion. They can provide a bonus for early completion and a penalty for late completion. This technique has been used in 35 states including Kentucky. For example, Florida has used a "no excuses bonus" through which a contractor will receive a bonus for completion in advance of a set date. There are no excuses, such as weather delays, and there are no disincentives, only liquidated damages.

  These provisions can enable the Cabinet to provide strong incentives for reducing project time where traffic inconvenience and delays have large costs to the public. Incentive/disincentive amounts can be based upon traffic safety, traffic maintenance, and road user delay costs. The disincentive makes it more important for the contractor to complete projects on time.

- **Innovative and nontraditional contracting**. Innovative and nontraditional contracting refers to construction procurement in which factors other than the low bid are considered. Examples include:

  - Cost plus time, called A + B bidding, includes time with an associated cost in the low bid process. "A" is the traditional bid item and "B" is the completion time bid by the contract; a dollar value per day is then set by the state. This type of bidding is used in 28 states and has been used on 11 occasions in Kentucky. This type of contract provision is meant to reduce the impact of construction upon road users. These user impacts are the costs of extra travel time due to construction delay and accidents in construction zones. This cost plus time approach can yield safety and road user cost benefits.

  - Lane rental provisions include an estimated fee for the time a contractor occupies or obstructs part of the roadway, which is deducted from monthly progress payments. The goal is to reduce road user impacts during construction. The Cabinet has used the provision on approximately 23 projects between 1999 and October 2003. Lane rental contract provisions are used in a number of other states.

  - Performance-related specifications and construction warranties specify how a finished product should perform over time. These can include physical durability, functional characteristics, user safety, and environmental impact. The Cabinet has used the provision on about 30 projects, and has used quality control and rideability as performance measures.

- Alternative project delivery techniques. The Cabinet currently delivers almost all its projects through a Design-Bid-Build approach in which a large portion of the design (some 70 percent) is performed by design consultants. Alternative project delivery techniques fall into two main categories. First are design/build techniques in which the Cabinet selects a single contractor to both design and build the project. Upon

construction, the Cabinet assumes responsibility for operation and maintenance. The Cabinet provides all the financing. Second are multi-consultant or program delivery models in which a general engineering contractor oversees consultant design work which is then let for construction at a certain level of design completion.

B. Question 1: Is the Commonwealth of Kentucky getting a competitive price through Construction Procurement?

There is strong concern on the part of policymakers that Kentucky taxpayers are not getting a fair price in the construction procurement process. This concern is magnified because of the large number of single-bid and two-bid construction projects over the past two fiscal years. In addition, a federal grand jury has been conducting an antitrust investigation of the highway construction industry in Kentucky and a number of newspaper articles have drawn attention to the historically high rate of single-bid contracts that have been awarded.

Also of concern are the allegations that some contractors intentionally submit very low bids to obtain the work and then change orders to earn a normal profit on the project.

1. Answer

Our findings indicate that there are two types of construction projects found in many parts of the state for which there is limited or no competition. Analysis of all construction projects let over the past two fiscal years finds that $300 million (26 percent) of a total of $1,135 million Six-Year Highway Plan projects were let through single-bid projects. Our findings further showed these projects were let at bid prices significantly closer to the engineer's estimate than were competitive projects.

Regardless, our analysis supports the basic economic theory that the consistent absence of competition results in the Cabinet's not getting a fair price on many construction projects. These findings provide evidence of what has been documented previously as a long standing concern. The Lexington Herald-Leader conducted an analysis of construction projects awarded from 1988 to mid-1994 and documented a very high incidence of single-bid contracts.[4] In 2001, a federal grand jury was convened to conduct an antitrust investigation into highway construction in Kentucky.[5]

In comparison to other states, Kentucky has experienced a considerably higher number and dollar value of single bid contracts.

The Cabinet has recently introduced new prequalification procedures for contractors that reflect industry best practice by providing an accountability mechanism to address contractors' performance. However, our findings indicate that both the management

[4] Lexington Herald-Leader, Final Edition, December 4, 1994.
[5] As reported in the Kentucky Courier-Journal, September 21, 2001.

practices and the technical approaches used for managing construction procurement, project estimation, and bid analysis do not reflect best practice.

In a low bid environment, the methodology used to develop the engineer's estimate is extremely important. The way the Cabinet prepares its final engineer's estimates needs strengthening because the current process is not standardized, is inconsistently applied, and is undocumented. Evidence shows that the final engineer's estimate for many projects is based on historical estimates, which themselves may be based on single-bid projects. Moreover, even if estimates are made on the basis of historical data that reflect projects with good competition, there is still room for error. Using historical costs as opposed to the actual costs that a contractor would incur in building a project (which requires the assembly of current prices for elements such as rock and other pavement materials, equipment rentals, labor, and asphalt), assumes that (1) past estimates were not in technical error; and (2) past projects used for comparison are truly comparable and not unique in ways that can skew the estimate in either direction. Neither is a safe assumption.

2. Analysis Strategy

a. Quantitative Analysis Approach

To evaluate competitiveness, the number of bids was used as an indicator for comparing projects of different work types and geographical locations. The dataset consisted of 302 Six-Year Highway Plan projects let in the last two fiscal years.

The Cabinet classifies projects in some 30 different types of construction work. For proposes of this analysis, types of work were grouped in the following five broad categories.

Exhibit VI-2: Categorization of Construction Work Type for Procurement Analysis

Type of Work	Description
Highway modernization/pavement reconstruction	Major highway projects including new construction and modernization.
Bridge reconstruction/ modernization	Bridge reconstruction.
Bridge preservation	Rehabilitation projects and those intended to preserve or enhance existing infrastructure.
Pavement preservation	Rehabilitation projects and those intended to preserve or enhance existing infrastructure.
Other	Miscellaneous Six-Year project listings: right of way, landscaping.

Exhibit VI-3 groups projects according to similar types of construction work as a basis for analysis. All projects listed are Six-Year Highway Plan construction projects let in the past two years.

Exhibit VI-3: Construction Procurement Projects Evaluated, Fiscal Year 2002 and 2003

Type of Work	Number of Projects	Award Amount ($)	Percentage
Highway Modernization/Pavement Reconstruction	137	643,889,995	57
Bridge Reconstruction/Modernization	81	305,558,110	27
Pavement Preservation	31	141,700,940	12
Bridge Preservation	6	13,975,485	1
Other	47	30,712,726	3
Total	**302**	**$1,135,837,256**	**100%**

Source: Kentucky Transportation Cabinet Decision Support System and Contractor Pay Estimate System.

In addition, the relationship between bid amounts and the engineers' estimates were used to further determine competitiveness for capital projects. Projects were grouped by number of bids and the average difference between the bid amount and engineer's estimate calculated for each group. The same exercise was performed by type of work and by district.

b. Analysis of Management Procedures and Technical Practice

This analysis involved assembling and reviewing any documented policies and procedures regarding prequalification, bid analysis, and estimation. These were supplemented by interviews with Cabinet employees to determine actual practice.

c. Best Practice Analysis

Quantitative data was collected from a number of neighboring states for benchmarking purposes. In addition, state-of-the-practice assessments were conducted for cost estimation and bid analysis drawing upon published documents, research literature, and interviews with the cost estimators association.

3. Findings – Quantitative Analysis

- **Forty nine projects had one bid and this accounted for 26 percent of the total awarded amount of Six-Year Highway Plan projects in the past two fiscal years.**

  As shown in Exhibit VI-4, 49 projects, 16 percent of all projects and 26 percent of the value of construction let, involved a single bid. A further 39 projects

representing 9 percent of the value of construction received 2 bids. This strongly indicates that for a large proportion of the program there is not a competitive construction procurement environment.

Exhibit VI-4: Number of Bidders by Number of Projects Let, Award Amount Compared to Engineer's Estimate (Six-Year Highway Plan Projects Let July 2001 to June 2003)

Number of Bids	Number of Contracts	Award Total Value ($)	Average Contract Award ($)	Average Award as Percent of Engineer's Estimate
1	49	299,439,344	6,111,007	-1
2	39	133,384,683	3,420,120	-18
3	43	186,925,969	4,347,116	-21
4	52	154,373,224	2,968,716	-21
5	36	154,237,346	4,284,371	-23
6	26	113,145,776	4,351,761	-23
7	27	59,433,231	2,201,231	-34
8	12	21,720,999	1,810,083	-28
9	7	5,524,319	789,188	-20
10	8	6,089,437	761,180	-98
11	2	656,181	328,090	-34
14	1	906,747	906,747	-2
Total	**302**	**$1,135,837,256**	**$3,761,050.52**	**-21.22%**

Source: Kentucky Transportation Cabinet Decision Support System and Contractor Pay Estimate System.

- **Single-bid projects are being let at a considerably higher cost than other projects. If single-bid projects had experienced the same bid patterns as those with two bids, Kentucky would have saved $53.8 million.**

  Further, if these single-bid projects received three bids, then $61.4 million would have been saved. The data dramatically indicate the financial impact of the lack of competition on many projects. It is also important to note that if all the projects that received two bids had the same patterns as those receiving three bids then Kentucky would have saved a further $9.6 million.

- **Overall there is limited competition on pavement projects of all types, whereas bridge projects are competitive.**

  Over 50 percent of the value of highway reconstruction and modernization work and 32 percent of the value of pavement preservation projects let in the past two fiscal years were awarded for projects that received a single bid. Exhibit VI-5 shows the number of project bids and their value by category of work type.

Exhibit VI-5: Number of Bids by Number of Projects and Dollar Value by Project Work Type (Six-Year Highway Plan Projects Let July 2001 to June 2003)

No. of Bids	Value of Projects by Type of Work															Number of Projects	Total Dollar Value	
	Highway Modernization			Bridge Reconstruction			Pavement Preservation			Bridge Preservation			Other					
	No.	$M	%	No.	$M	%	No.	$M	%	No.	$M	%	No.	$M	%		$Million	%
1	23	169.9	27.1	5	15.4	14.4	17	96.3	60.7	2	2.2	1.0	2	15.6	49.8	49	299.44	26.4
2	15	86.1	13.8	4	6.5	6.1	12	34.1	21.5	4	2.7	1.3	4	3.8	12.2	39	133.38	11.7
3	17	75.2	12.0	3	4.7	4.3	5	13.5	8.5	9	90.7	42.8	9	3.0	9.5	43	186.93	16.5
4	18	111.6	17.8	3	0.8	0.8	2	12.3	7.8	10	25.5	12.0	19	4.1	13.1	52	154.37	13.6
5	11	55.5	8.9	9	71.2	66.3	2	2.2	1.4	7	23.2	11.0	7	2.0	6.5	36	154.24	13.6
6	13	56.4	9.0	1	0.5	0.5	0	-	0.0	10	55.5	26.2	2	0.7	2.3	26	113.15	10.0
7	17	52.8	8.4	6	5.9	5.5	1	0.1	0.1	1	0.2	0.1	2	0.3	1.1	27	59.43	5.2
8	8	16.0	2.6	1	0.4	0.4	0	-	0.0	2	5.2	2.5	1	0.1	0.4	12	21.72	1.9
9	2	0.4	0.1	3	0.8	0.7	0	-	0.0	2	4.3	2.0	-	-	0.0	7	5.52	0.5
10	3	2.2	0.3	1	0.8	0.7	0	-	0.0	3	2.4	1.1	1	0.7	2.2	8	6.09	0.5
11	1	0.3	0.0	1	0.4	0.4	0	-	0.0	0	-	0.0	-	-	0.0	2	0.66	0.1
14	0	-	0.0	0	-	0.0	0	-	0.0	0	-	0.0	1	0.9	2.9	1	0.91	0.1
Total	**128**	**626.3**	**100%**	**37**	**107.5**	**100%**	**39**	**159**	**100%**	**50**	**212.0**	**100%**	**48**	**31.4**	**100%**	**302**	**$1,135.84**	**100.0**

Source: Kentucky Transportation Decision Support System and Contractor Pay Estimate System.

- **Districts 2, 7, 9, and 12[6] together account for the majority of single bid contracts and experienced the least competition between July 2001 and June 2003.**

  Exhibit VI-7 shows the number of bids on projects let in each District. In Districts 2, 7, and 9, single bid contracts account for almost 50 percent or more of the value of projects let. In District 12, they account for over a third. Taken together Districts 2, 7, 9, and 12 accounts for 84 percent of all single bid awards, but only 37 percent of total projects, as illustrated in Exhibit VI-8.

  The location of the districts are shown in Exhibit VI-6 below.

Exhibit VI-6: Commonwealth of Kentucky Highway Districts

[6] District 2 – includes Caldwell, Christian, Davess, Hancock, Henderson, Hopkins, McLean, Muhlenberg, Ohio, Union, and Webster Counties.

District 7 – includes Anderson, Bourbon, Boyle, Clark, Fayette, Garrard, Jessamine, Madison, Mercer, Montgomery, Scott, and Woodford Counties.

District 9 –includes Bath, Boyd, Carter, Elliott, Fleming, Greenup, Lewis, Mason, Nicholas, and Rowan Counties.

District 12 –includes Floyd, Johnson, Knott, Lawrence, Letcher, Martin, and Pike Counties.

Exhibit VI-7: Number of Projects Let by District
(Six-Year Highway Plan Projects Let July 2001 through June 2003)

Number of Bids	District 1 – Paducah	District 2 – Madisonville	District 3 – Bowling Green	District 4 – Elizabethtown	District 5 – Louisville	District 6 – Covington	District 7 – Lexington	District 8 – Somerset	District 9 – Flemingsburg	District 10 – Jackson	District 11 – Manchester	District 12 – Pikeville	Number of Projects
1	3	8	1	3	-	5	9	1	7	4	2	6	49
2	8	5	3	8	2	1	1	-	1	1	5	4	39
3	1	3	4	4	5	7	5	4	1	1	1	7	43
4	1	6	3	4	4	7	5	3	6	3	7	3	52
5	3	4	1	3	4	5	4	1	6	1	1	3	36
6	2	2	2	3	3	6	-	2	1	3	1	1	26
7	-	1	-	5	2	7	-	1	3	5	2	1	27
8	-	-	-	4	1	-	2	1	2	2	-	-	12
9	1	-	-	-	-	-	2	3	-	1	-	-	7
10	-	1	-	2	2	-	1	-	1	1	-	-	8
11	-	-	-	1	-	-	1	-	-	-	-	-	2
14	-	-	-	-	-	-	1	-	-	-	-	-	1
Total	**19**	**30**	**14**	**37**	**23**	**38**	**31**	**16**	**28**	**22**	**19**	**25**	**302**

Source: Kentucky Transportation Cabinet Decision Support System and Contractor Pay Estimate System.

Exhibit VI-8: Value of Projects Let by Number of Bids by District
(Six-Year Highway Plan Projects Let July 2001 through June 2003)

Number of Bids	Value of Projects by District (in millions)												Number of Projects	Total Value
	District 1 – Paducah	District 2 – Madisonville	District 3 – Bowling Green	District 4 – Elizabethtown	District 5 – Louisville	District 6 – Covington	District 7 – Lexington	District 8 – Somerset	District 9 – Flemingsburg	District 10 – Jackson	District 11 – Manchester	District 12 - Pikeville		
1	$1.3	$32.7	$4.8	$7.2	-	$7.5	$117.3	$7.1	$49.5	$7.0	$13.8	$51.2	49	$299.4
	4.4%	54.4%	6.2%	9.6%	0.0%	6.0%	57.5%	10.8%	48.1%	20.7%	24.4%	32.4%		26%
2	$12.8	$15.6	$47.1	$9.4	$24.2	$2.7	$3.2	$-	$1.8	$6.7	$5.8	$4.0	39	$133.4
	42.8	26.0	61.0	12.5%	16.4%	2.2%	1.6%	0.0%	1.8%	19.8%	10.3%	2.5%		12%
3	$1.0	$0.9	$7.1	$11.4	$13.0	$21.8	$25.7	$6.6	$0.1	$0.2	$1.1	$98.1	43	$186.9
	3.2%	1.5%	9.2%	15.2%	8.8%	17.5%	12.6%	10.1%	0.1%	0.6%	1.9%	62.0%		16%
4	$6.7	$1.1	$13.6	$2.0	$6.3	$32.5	$24.3	$1.2	$31.9	$1.5	$31.0	$2.4	52	$154.4
	22.3%	1.8%	17.6%	2.6%	4.3%	26.1%	11.9%	1.8%	31.0%	4.3%	54.7%	1.5%		14%
5	$2.4	$3.7	$0.3	$0.6	$85.0	$18.0	$25.7	$0.3	$14.9	$1.5	$0.3	$1.7	36	$154.2
	8.1%	6.1%	0.3%	0.8%	57.7%	14.4%	12.6%	0.4%	14.5%	4.3%	0.6%	1.0%		14%
6	$1.8	$0.8	$4.4	$3.6	$15.0	$22.3	$-	$49.7	$1.1	$13.6	$0.4	$0.5	26	$113.1
	5.9%	1.4%	5.7%	4.8%	10.2%	17.9%	0.0%	75.3%	1.1%	39.8%	0.7%	0.3%		10%
7	$-	$4.8	$-	$26.5	$0.7	$19.8	$-	$0.1	$0.9	$2.1	$4.1	$0.4	27	$59.4
	0.0%	8.1%	0.0%	35.3%	0.5%	15.9%	0.0%	0.1%	0.9%	6.2%	7.2%	0.2%		5%
8	$-	$-	$-	$11.7	$1.4	$-	$5.4	$0.3	$1.9	$1.0	$-	$-	12	$21.7
	0.0%	0.0%	0.0%	15.6%	1.0%	0.0%	2.6%	0.5%	1.8%	2.8%	0.0%	0.0%		2%

Number of Bids	Value of Projects by District (in millions)												Number of Projects	Total Value
	District 1 – Paducah	District 2 – Madisonville	District 3 – Bowling Green	District 4 – Elizabethtown	District 5 – Louisville	District 6 – Covington	District 7 – Lexington	District 8 – Somerset	District 9 – Flemingsburg	District 10 – Jackson	District 11 – Manchester	District 12 - Pikeville		
9	$4.0	$-	$-	$-	$-	$-	$0.6	$0.7	$-	$0.3	$-	$-	7	$5.5
	13.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1.1%	0.0%	0.7%	0.0%	0.0%		0%
10	$-	$0.4	$-	$2.4	$1.8	$-	$0.5	$-	$0.8	$0.2	$-	$-	8	$6.1
	0.0%	0.7%	0.0%	3.1%	1.2%	0.0%	0.3%	0.0%	0.8%	0.7%	0.0%	0.0%		1%
11	$-	$-	$-	$0.3	$-	$-	$0.4	$-	$-	$-	$-	$-	2	$0.7
	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%		0%
14	$-	$-	$-	$-	$-	$-	$0.9	$-	$-	$-	$-	$-	1	$0.9
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%		0%
Total	**$29.9**	**$60.0**	**$77.2**	**$75.1**	**$147.5**	**$124.6**	**$204.0**	**$66.0**	**$102.8**	**$34.1**	**$56.6**	**$158.2**	**302**	**$1,135.8**
	100%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: Kentucky Transportation Cabinet Decision Support System and Contractor Pay Estimate System.

- **In Districts 2, 7, 9, and 12, lack of competition results in projects being let at higher costs than for projects with more than one bidder.**

  Analysis of the relationship between the bid award and the engineer's estimate shows that in districts 2, 7, 9 and 12, which accounted for 84 percent of single bid projects. In contrast, the award amount on competitive projects is considerably less than the engineer's estimate. This strongly indicates that the Commonwealth of Kentucky is experiencing higher construction costs due to lack of competition in these Districts.

  Exhibit VI-9 provides the results of the analysis between the engineer's estimate, the award amount and the number of bids for selected districts.

Exhibit VI-9: Project Award Compared to Engineer's Estimate for Districts 2, 7, 9 and 12 (Six-Year Highway Plan Projects Let July 2001 through June 2003)

No. of Bids	District								Award Value ($)	No. of Contracts
	District 2 – Madisonville		District 7 – Lexington		District 9 – Flemingsburg		District 12 – Pikeville			
	Average Award ($M)	Percent of Engineer's Estimate	Average Award ($M)	Percent of Engineer's Estimate	Average Award ($M)	Percent of Engineer's Estimate	Average Award ($M)	Percent of Engineer's Estimate		
1	0.7	3.4	2.4	-0.3	1.0	-3.8	1.0	0.5	299.4	49
2	0.4	-8.4	0.1	6.5	0.0	18.1	0.1	-10.1	133.4	39
3	0.0	-44.3	0.6	-15.2	0.0	-33.1	2.3	-27.8	186.9	43
4	0.0	-13.9	0.5	-18.3	0.6	-18.6	0.0	-19.0	154.4	52
5	0.1	-46.1	0.7	-34.3	0.4	-31.8	0.0	-14.7	154.2	36
6	0.0	-13.8	0.0	NA	0.0	-33.0	0.0	-18.6	113.1	26
7	0.2	-14.6	0.0	NA	0.0	-63.0	0.0	0.3	59.4	27
8	0.0	NA	0.4	-27.8	0.2	-21.5	0.0	NA	21.7	12
9	0.0	NA	0.1	-8.7	0.0	NA	0.0	NA	5.5	7
10	0.0	-370.4	0.1	-10.9	0.1	-28.0	0.0	NA	6.1	8
11	0.0	NA	0.3	-12.7	0.0	NA	0.0	NA	0.7	2
14	0.0	NA	0.9	-1.8	0.0	NA	0.0	NA	0.9	1

Source: Kentucky Transportation Cabinet Decision Support System and Contractor Pay Estimate System.

- **The relationship between competition and price is most pronounced for pavement projects.**

  Exhibit VI-10 demonstrates that roadway projects compared to bridge projects clearly cost more with less competition.

Exhibit VI-10: The Average Percentage Difference between the Engineer's Estimate and the Award Amount By Number of Bids (Six-Year Highway Plan Projects Let July 2001 through June 2003)

Number of Bids	Average Award Under Kentucky Transportation Cabinet Estimate						
	Highway Reconstruction/ Modernization	Bridge Reconstruction/ Modernization	Pavement Preservation	Bridge Preservation	Other	Award Value ($)	Number of Contracts
1	-1.2%	6.0%	0.2%	-20.8%	-2.0%	299.4	49
2	-14.2%	-5.3%	-36.1%	6.5%	-14.9%	133.4	39
3	-18.4%	-31.6%	-29.2%	-19.3%	-21.0%	186.9	43
4	-21.1%	0.9%	-42.2%	-14.2%	-25.3%	154.4	52
5	-22.0%	-29.7%	-33.0%	-13.1%	-23.6%	154.2	36
6	-28.3%	-18.6%	NA	-12.5%	-47.9%	113.1	26
7	-42.4%	-10.6%	-36.3%	-16.9%	-35.2%	59.4	27
8	-27.1%	-41.1%	NA	-29.3%	-20.5%	21.7	12
9	-31.3%	-16.3%	NA	-12.6%	NA	5.5	7
10	-136.6%	-28.0%	NA	-59.4%	-171.2%	6.1	8
11	-55.6%	-12.7%	NA	NA	NA	0.7	2
14	NA	NA	NA	NA	-1.8%	0.9	1

Source: Kentucky Transportation Cabinet Decision Support System and Contractor Pay Estimate System.

- **Compared to neighboring states.**

  Data assembled from other states show that Kentucky has a higher prevalence of single bid projects.

Exhibit VI-11: Number of Bids per Project Let: Kentucky Compared to Other States

Number of Bids	Kentucky	Colorado	Georgia	Indiana[a]	Ohio
1	16.2%	2.0%	7.4%	7.3%	5.38%
2	12.9%	6.9%	15.6%	19.7%	13.90%
3	14.2%	17.8%	21.3%	21.1%	21.43%
4	17.2%	18.8%	18.9%	15.7%	18.48%
5	11.9%	20.8%	18.9%	13.6%	12.47%
6+	27.5%	33.7%	18.0%	22.6%	28.34%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

[a] Projects for 2001 and 2002.

4. Findings – Analysis of Management and Business Practices

- **Prequalification**

  – **Since January 2002, the Kentucky Transportation Cabinet, under its Quality-Based Prequalification Process, reflected best practices in contractor prequalification.**

    In January 2002, a new prequalification process was implemented. The Cabinet's contractor prequalification process takes into account not only a firm's capacity in terms of financials and equipment, but also its past performance for the Cabinet. This process reflects industry best practices because it augments the low-bid approach with useful and objective measurement of factors, other than cost, that provide value to the traveling public and to the Cabinet. Dye Management Group, Inc. did not evaluate how the process has been used to date because it is a new process. A key issue for future analysis will be to identify any contractors who perform poorly and then determine if this poor performance affects their qualification status.

  – **The Kentucky Transportation Cabinet's prequalification process is well defined.**

    Contractors are evaluated each year for eligibility, which determines the type(s) and monetary value of work that a contractor is eligible to bid on. The contractor's level of prequalification is summarized in a Certificate of Eligibility. Prequalification is important in ensuring that the firms bidding

have the financial resources and technical capacity to perform the work they are bidding on.

The advantage of considering the contractor's past performance in establishing prequalification is two-fold. First, bid amount is not the only metric that matters to the Cabinet. Factors such as schedule adherence, mitigation of impacts on the traveling public, quality, and cooperation are also important. Second, knowing that they will be evaluated on every project and that this evaluation will have a material effect on their eligibility provides contractors with a strong incentive to meet the Cabinet's performance criteria.

The Cabinet strives to ensure objectivity and consistency in the performance evaluation process through the following:

- Specifying evaluation and scoring criteria.
- Providing a check on the Resident Engineer's view by requiring Chief District Engineer input.
- Allowing contractors to review their evaluations and appeal the results.

Eligibility is computed by comparing performance (along with two other factors) against the contractor's financial status.

- **The Final Engineer's Estimate**

  - **Procedures for establishing the engineer's estimate at the Kentucky Transportation Cabinet are not subject to standardized business rules and are not well documented relative to other states.**

    Many states have detailed rules and procedures around the production of final engineer's estimates. For example, Colorado, New Jersey, and Washington have detailed cost estimating design manuals that are from 65 to more than a 100 pages in length. The Cabinet's final cost estimates rely on an informal set of notes accumulated over time.

  - **The management, organization, and approach to cost estimation do not reflect best practice.**

    Whereas it is mandatory that an independent cost estimator prepare the final engineer's estimate at DOTs considered to use best practices, Cabinet design staff have the option of preparing their own final engineer's estimate. There are at least two drawbacks to allowing designers to prepare final engineer's estimates. First, highway design and estimating are separate technical disciplines, each requiring technical expertise and professional judgment. This makes each an "art" as well as a science. Second, it is important that there be consistency in the preparation of estimates. It is difficult to maintain current knowledge of market conditions and prices (as in petroleum for asphalt paving). Yet, the estimator's job requires this current knowledge.

- **Some estimators at the Kentucky Transportation Cabinet appear to be developing final engineer's estimates on the basis of costs established in prior single-bid contracts.**

  The use of historical bid data for estimation purposes continues past practices and diminishes the competitive environment. Our interview results find a current practice of using past bid prices, often from a procurement that had little competition, as an input in establishing the engineer's estimate. This practice can reinforce a non-competitive environment, especially if the Cabinet's bid analysis process is based solely on the engineer's estimate.

  When the Cost Estimator has built a final engineer's estimate from the ground up, and has the data to support it, it is this estimate, not the bids subsequently received, that should provide the benchmark against which bids are analyzed. To do otherwise is to risk (1) perpetuation of bids based on flawed or inflated historical estimates; (2) loss of control of public resources to the private sector. Assume, for instance, that three bids are received, all within 5 percent of one another, but each at least 15 percent over the engineer's estimate. This does not necessarily mean that the engineer's estimate is too low and that the Cabinet should therefore award the lowest bid. It may mean that the contractors themselves have come to similar conclusions regarding the value of an award based on their own analyses of the Cabinet's award history. It could also mean that the environment is not truly competitive. In short, the only way to guarantee that the Cabinet is receiving the best value for its construction dollars is to develop and consistently apply best practices in cost estimating, which involve careful attention to actual costs. What one wants to know is the actual cost to the contractor to build the project as opposed to what the Cabinet has paid in the past for similar work. They are not one and the same.

- **The preparation of final engineer's estimates at the Kentucky Transportation Cabinet is not being actively managed.**

  Although the Cabinet has a Prequalification Committee and an Award Committee, it does not have an Estimate Committee as do other states, including Georgia. At the Cabinet, there is a lack of attention to and oversight over the cost estimating process, despite the fact that the Cabinet's final engineers' estimates are used to award multi-million dollar contracts.

  In developing the final engineer's estimate, the Cabinet's cost estimator uses the designer's calculation of the work items and quantities that a given project is expected to entail based on project features such as grade, drainage, and geotechnical conditions. Work items include materials, such as asphalt mix, concrete, and structural steel which are bid on a unit cost basis and construction processes, such as mobilization, which are bid on a lump sum basis. The cost estimator then compares the Project Specification & Estimate package against the designer's calculated quantities to detect

errors and omissions in design or quantities that would emerge at the construction stage if not corrected prior to letting. The Project Specification and Estimate package is returned to the designer for any needed corrections.

Once the quantities have been established, the cost estimator applies an estimate of unit prices to each work item. The sum of the work items times the unit price or lump sums is the overall final engineer's estimate. Bidders receive the long list of work items without the Cabinet's estimated unit and lump sum prices. Bidders apply their prices to each work item. The Cabinet can then compare the bids to the final engineer's estimate on a line item basis. The bids vary in both unit prices for materials and lump sum prices for work items.

There is evidence that some estimators are basing their work on prior single-bid contracts. The Cabinet attempts to gather actual cost figures for "big ticket" items such as asphalt. Materials can account for 70 to 80 percent of the cost of a project, and these costs are among the most variable. Meanwhile, costs for relatively minor items, such as signage and lighting, are estimated on the basis of historical bids, sorted by geographic area. These costs can be collected, analyzed, and updated for the database/program used by estimators. Regardless of whether the data used to develop the estimate are historically based or actual costs, it is very important that the estimator consider the project in all its dimensions. Accuracy in cost estimates requires understanding factors such as the need to accommodate urban traffic, which may require special phasing. In essence, accuracy requires building the final engineer's estimate from the ground up. Knowing what a project will cost a contractor to build and knowing what the Cabinet paid in the past for similar work are not the same.

In a perfect market, competition would ensure that the Kentucky Transportation Cabinet receive multiple bids reflecting the true, lowest cost of providing the project. However, the market is not perfect. The consolidation of contractors in parts of the state, along with vertical market integration resulting from large firms acquiring materials suppliers as well, has led to a large number of one-bid situations.

If the engineer's estimate is too high, the Commonwealth will likely overpay for a project. If the engineer's estimate is too low, then it may reflect poor design and/or estimating work within the Cabinet or its consultants.

To obtain accurate estimates using the actual cost approach, the estimator must have current costs on items including materials, plant production costs, equipment rental costs, haul costs, and labor and overhead costs. The ability to access actual cost information was cited as an issue by the Cabinet's Cost Estimating staff. It can be challenging to maintain current cost data because contractors and their suppliers may be wary of revealing

any cost information that could be used by a competitor or by the Cabinet to chip down their bid price. Therefore, best practices in maintaining cost data entail gathering data from a variety of sources. For instance, a cost estimator for the Georgia DOT stays in regular contact with resident engineers in the districts who may gather information through informal discussions. This informal information can be used to build and maintain an accurate cost database.

- **Engineer's estimate confidentiality.**

  Practices among the states regarding disclosure of the final engineer's estimate vary. Many states never disclose this estimate. However, other states do disclose the final engineer's estimate at different points in the letting process.

- **Contract Award and Market Analysis**

  - **There are no written policies, procedures, or business rules for bid award analysis.**

    Decisions to award, reject, defer, or rebid a given contract are left to the discretion and collective judgment of a four-person Award Committee. This is not the norm among state departments of transportation, many of which not only require the justification of bids that deviate from the final engineer's estimate, but also place the authority for final decisions on contract letting in the hands of oversight committees such as transportation commissions.

  - **The Kentucky Transportation Cabinet does not perform a systematic market analysis of construction bids and contracts.**

    Thirty-four states have a systematic approach and business function that tracks and analyzes materials and labor costs and scrutinizes bids to detect collusion. The Cabinet does not perform this business function, although it has the capability to, but seems to focus mainly on maintaining records.

  - **The contract award committee conducts bid award analysis.**

    Decisions to award, defer, reject, or rebid the Cabinet's contracts are made by an Award Committee, which currently comprises the State Highway Engineer, the Executive Director of the Office of Project Development, the Executive Director of the Office of Construction and Operations, and the Director of the Division of Contract Procurement. This committee has a great deal of discretion; the consultant team was told that there are no written rules or procedures governing the disposition of bids relative to the final engineer's final estimate.

    At the Cabinet, special justification is not required to accept a bid that is either much higher or lower than the final engineer's estimate, although committee members offered perspectives on how they treat bids that deviate

significantly from the engineer's estimate. During interviews, they described the current approach as follows:

- If there are at least three bids very close to one another, but significantly above the final engineer's estimate, the bids would be examined in detail relative to the proposal to see whether and how some work element had been underestimated. In such a case, it would not be unusual for the Cabinet to award the project to the low bidder.
- If there is only a single bidder, but the project is very high priority, it may be awarded, even if the bid exceeds the engineer's estimate.
- If the bids come in considerably lower than the engineer's estimate, the Committee may have the cost estimator go back to the drawing board and develop a revised estimate based on the additional data provided in the bids.
- If there is a unique project, or a project that uses a new technique for which there is no historical data and where actual cost data are difficult to obtain, rebidding may be required if the bid deviates from the engineer's estimate.

C. Question 2: Are incentive and disincentive provisions being used effectively?

- **Are the level and types of incentives comparable to other states' practices?**

  The Kentucky Transportation Cabinet has been heavily criticized for its management of, and use of incentives on, a major project on I-64 in Jefferson County, the first major renovation in 30 years of a 3.3-mile stretch between Watterson Expressway and Grinstead Drive. The Cabinet has acknowledged misjudgment in its approach to this project. The initial engineer's estimate for the project came in at 800 hours and entailed closing the interstate on some nights,. After initial bids came in high, the Cabinet expanded the estimate to 1,000 hours. The contractor team, led by Gohmann Asphalt and Construction of Clarksville, Indiana, was able to complete the project in half the time estimated by the Cabinet. As a result of the contract's incentive structure, the contractor received a $5.3 million bonus on a $21 million job, a 25 percent bonus. The Cabinet was further criticized because Indiana, where the firm is headquartered, also offers contract incentives, though these are capped at 8 percent and generally run about 4 percent. Kentucky's General Assembly has since enacted a law that caps incentive payments at 5 percent of the total contract amount. This experience raised concerns regarding the extent and appropriateness to which incentives are used on some projects.

1. Answer

The Cabinet has exercised good judgment in starting to use incentive and disincentive contract provisions to ensure that projects are completed on time or even ahead of time.

Since 1999, incentive provisions have been included in approximately 21 projects. Incentive payments have been made to date on 18 projects and disincentives collected on 11. With the exception of the $5.3 million incentives paid on the Interstate-64 project, a total of $9.3 million has been paid in incentives between 1999 and 2002, with most payments being under 5 percent of the award amount.

2. Analysis Strategy

To quantify the use and effectiveness of incentives: the type, number, and amount of incentives were analyzed for all projects let since 1999.

- Projects with incentives greater than 5 percent of the awarded amount were analyzed as a measure to determine excessive use of incentives. For these projects, the number of bids was also analyzed.
- Assessed whether Kentucky's experience is different than that of neighboring states.

3. Findings

- **The Kentucky Transportation Cabinet has begun to use incentive payments to good effect.**

  With the exception of the Interstate-64 project, incentives are being used to good effect – namely, to make sure projects are completed on time with minimal disruption to the traveling public. While Dye Management Group, Inc. did not evaluate how the value of the incentives were computed, applied correctly the Cabinet's methods would provide incentives with a positive return for the public from early completion creating a win-win situation.

  Exhibit VI-12 details the number of times that different incentive and disincentives have been used on projects let since 1999. The Exhibit shows that incentives are used to pay contractors for each day they complete projects before a fixed completion date.

Exhibit VI-12: Projects that have had Incentive and Disincentive Clauses and Incentives Paid Between 1999 and 2003

	Cost per Day ($)			
	0 – 5,000	5,000 – 10,000	10,000 – 25,000	
Incentives	Number of Projects			**Other**
Fixed Completion Date	5	9	2	2 lump sum, 1 hourly ($4,500)
Lane Closure			1	2 hourly ($500 and $1,000)
Working Days			1	
Bridge Closure		1		
Disincentives				
Fixed Completion Date	7	9	2	7 liquidated damages
Lane Closure	2	1	1	3 liquidated damages
Working Days				
Bridge Closure				
	Cost per Hour ($)			
	0 – 500	500 – 1,000	>1,000	
Lane Rental	Number of Projects			**Other**
Fixed Completion Date	3	6	8	1 lump sum ($50,000)
Lane Closure		1	1	Liquidated damages
Working Days			1	
Bridge Closure				

- **Managed effectively, incentives provide a valuable tool for reducing user costs and disruption to the traveling public.**

  As indicated above, the Cabinet has limited experience in using incentives but should continue to use them where appropriate. For example, even though the Cabinet was subject to considerable criticism regarding the extent of incentive payments, the Cabinet won the National Partnership for Highway Quality's Gold Award for "Making a Difference" based on its approach to rehabilitation work on the heavily traveled 3.5-mile stretch of I-64 near Louisville. This "Risk Taking Award" was given because of the Cabinet's unusual approach. Instead of closing a few lanes and making the improvements in a piecemeal fashion over many months, as is often the norm, the Cabinet and its contractors closed the segment entirely until the work was completed. This created a safer environment for workers and allowed them to complete the work 7 weeks sooner than would otherwise have been possible. The incentive structure rewarded timely completion.

- **Incentive payments are in line with industry practice.**

  Excluding the Interstate-64 project, the Cabinet has paid $9.3 million in incentive payments; these amount to 4 percent of the total award amount on these projects. Disincentive payments in the amount of $38,000 have been collected. In general, the objective is for the contractor not to incur disincentive payments but to complete the work on time. Therefore, a low number for disincentives is good. Our analysis did not assess whether disincentive payments were due but not collected; however, we have received no indication that this is the case.

D. Question 3: Is the Commonwealth of Kentucky making use of innovative and non-traditional contracting approaches?

Many states use innovative and nontraditional contracting approaches to increase the speed of construction, reduce user costs, and minimize disruption to the traveling public. The Cabinet has been using A+B and A+B-C contracting.

1. Answer

There has been a very limited use of nontraditional contracting approaches. The Cabinet has taken a cautious approach to this type of contracting. Between 1999 and 2003, 2 projects were let that involved A+B bidding and 2 that involved A+B-C.

2. Analysis Strategy

Our approach involved assembly and analysis of data on the use of innovative contracting.

3. Findings

- **The Transportation Cabinet has made limited use of innovative contracting.**

  While the Cabinet has started to use incentive and disincentive provisions and lane rentals, it has been slow to use innovative bidding procedures. These can offer significant business benefits on projects by shortening the construction period and by valuing the completion time bid by the contractor. In this way, earlier completion lowers the bid price.

- **How A+B Bidding is applied by the Transportation Cabinet.**

  In “A+B” bidding, bids are taken for an “A” component of the contract and a “B” component of the contract. The “A” value includes materials and labor for completion of work specified in the contract. The “B” value of the contract is the number of days bid by the contractor for completion of the project. The value of time (days, hours, etc.) is determined by calculating the user delay costs of vehicles traveling through the work zone at reduced speeds, or the costs associated with

adverse travel when traffic is diverted to detour routes. The value of each unit of "B" is typically determined on Cabinet projects for "user delays in the work zone" using FHWA Publication "SA-98-079, Life Cycle Cost Analysis in Pavement Design." If adverse travel on detours is involved, user costs will include the costs of added mileage for adverse travel plus delay costs associated with capacity reductions on the detour route. The Cabinet's project team determines the maximum value for "B". This determination is based on anticipated production capacities and other project considerations.

The contract is awarded to the contractor with the lowest combined "A+B".

The following example illustrates the concept of "A+B" bidding. For this example, the following parameters apply:

Maximum Value if "B" specified by the Cabinet is 150 days.
The Value of B is $3,000 per day.

"Contractor XX"

Value of "A": $10,550,000
Number of Days Bid to complete Project: 140 days
Value of "B": 140 x $3,000= $420,000

Total Bid for Comparison Purposes Only:
"A+B" = $10,550,000 + $420,000 = $10,970,000

"Contractor YY"

Value of "A": $10,600,000
Number of Days Bid to complete Project: 122 days
Value of "B": 122 x $3,000= $366,000

Total Bid for Comparison Purposes Only:
"A+B" = $10,600,000 + $366,000 = $10,966,000

The low bid is ***"Contractor YY"*** with a low total of $10,966,000. Once the contract is awarded, the contract is for an "A" value of $10,600,000. If the contractor completes the project earlier than 122 days, an incentive of $3,000 per day is earned. Conversely, if the project is completed in more than 122 days, the contractor is assessed a disincentive of $3,000 per day.

For example, if the project is completed in 100 days, the contractor would earn an incentive of 22 days x $3,000 per day = $66,000. Conversely, if the contractor takes 150 days to complete the project, a disincentive would be assessed of 28 days x $3,000 per day = $84,000.

- **How A+B-C Bidding is applied by the Transportation Cabinet.**

  "A+B-C" includes a component; the value associated with an extended warranty for pavement performance. The value of "C" is determined as a function of the user costs associated with future rehabilitation costs. The contract is awarded to the contractor with the lowest combined "A+B-C".

- **The Transportation Cabinet is piloting design-build projects.**

  The Cabinet was given authority in the 2001 legislative session to pilot 5 projects for design/build. The experience has been positive to date. Design-build should be used selectively but has the potential to move projects quickly through to completion. The Cabinet views its Christian/Trigg US 68 project as the most successful design-build experience to date. This is a project where the Cabinet originally constructed two lanes along the existing two lanes to make a four lane facility. This did not improve the existing two lanes to meet current geometric criteria. The design/build project went in and updated the existing two lanes by adding shoulders, improving sight distance, and providing other features at a cost of $16.6 million.

E. Recommendations

1. Recommendation VI-1: Make increasing construction procurement competitiveness a top management priority for the Transportation Cabinet and report progress quarterly to the General Assembly.

There are no simple answers to increasing the competitiveness of construction procurement. The purpose of this recommendation is to elevate to the highest levels the management of and accountability for construction procurement. Among the immediate actions recommended are:

- Publish a rolling tentative 12-month letting schedule that indicates anticipated projects that will likely be advertised on the website. This will provide information on upcoming projects.
- Revise the process for awarding contracts by establishing written policies, procedures, and business rules. Areas to address are bid evaluation with respect to the engineer's estimate and procedures for single- and two-bid projects. Apply best practices used in other states for managing low bid environments, to include following up with plan holders or other qualified contractors to determine why they did not bid. Other practices include rebiding projects.[1]

[1] Georgia Department of Transportation reported that between 1995 and 2003 on projects that were rebid, 90 percent of the new bids were for a lower amount. This yielded a direct savings of $30 million.

- Establish a standard set of summary bid analysis reports for the General Assembly and the public on market competitiveness through the work of the markets analysis section (see recommendation VI-2 below).
- Identify and implement an action strategy for increasing competitiveness beyond those measures identified above. Among the issues to evaluate are current specifications practices, project timing, project size, or other practices limiting competition.
- Evaluate options and feasibility for the state to establish material sources (such as quarries) to introduce competition.

2. Recommendation VI-2: Establish a cost estimating and markets analysis section to strengthen the development of engineer's estimates and perform bid analysis.

This newly established section would review and establish new standardized business rules for developing engineers' estimates and conducting market analysis to support these estimates.

The new approach should be cost-based estimating, which reflects the contractor's actual costs to produce the project as opposed to what the Cabinet has paid for similar work in the past. This approach will account for different costs in different parts of the state and provide a basis to evaluate whether or not a fair price is being secured.

The section should determine whether the nondisclosure practice is effective and, if it is not, how to change this practice to ensure the integrity of nondisclosure.

In addition, this section should use the Bid Analysis and Management System/Decision Support System (BAMS/DSS) module within the AASHTO Trans-Port software package to evaluate and report on factors that indicate the risk of collusion. The types of analysis performed using the BAMS to indicate potential collusion are shown in Exhibit VI-12.

Exhibit VI-13: Type of Collusion Analysis

Type of Collusion	Description
Complementary Bids	A pattern of consistently high bids, or non-response of bidders (e.g., unqualified bidders or incorrectly submitted bids) made to give the appearance of competition in order to influence the decision to award the project to a predetermined bidder.
Territorial Allocation	A pattern of consistent wins by a bidder within a specific area (e.g., county or multi-county area).
Joint Ventures	Submission of a "complementary" bid or other noncompetitive bid by an eventual partner (i.e., subcontractor, supplier, etc.) to the successful bidder.
Bid Rotation	A coordinated pattern of win and loss bid responses to assure that a predetermined bidder submits the lowest bid.

3. Recommendation VI-3: Use innovative contracting provisions that can reduce late or ensure on-time construction for projects with high roadway user costs.

This recommendation involves the Cabinet using contracting provisions that will provide incentives and place value on completing construction work faster. Incentives to be considered should include bonus payments for early completion or valuing time to complete A+B contracting. The recommendation has the potential to reduce user costs incurred by delay during construction and improve safety.

VII. Construction Change Order Management, Schedule, and Cost Performance

■

This section evaluates change order management and the extent to which construction projects are completed on schedule and within budget. Change orders authorize changes to the work specified in the construction contract. Change orders are made for a number of reasons. These include changing material specifications and quantities, performing additional work, addressing unforeseen situations, completing design details, repairing design omissions and errors, or performing other changes. This section addresses the extent to which construction projects are completed on schedule and within budget.

The questions evaluated are:

- **Question 1:** What is the magnitude and cause of change orders?
- **Question 2:** Does the Transportation Cabinet have effective management controls and procedures for change order management?
- **Question 3:** Is construction delivered on schedule and within budget?
- **Question 4:** Does the Transportation Cabinet apply the appropriate level of resources to construction engineering?

A. Background

Over the past two years, the Cabinet has overseen the completion of over 400 construction projects with a total construction cost of approximately $1.5 billion. These projects are all built by the highway construction industry under contract to the Kentucky Transportation Cabinet. Background on the management and accountability mechanisms for construction delivery is summarized below.

1. Construction Schedules

The Cabinet specifies a construction time in the construction contract prior to letting. Project schedules are established as either:

- **Specified dates of completion**. The most common type of contract is the one which specifies a date for completion. The contractor may start work at any time.
- **Working days**. These contracts specify a certain number of days a contractor is able to work on the project. This type of contract gives the contractor so many

normal working days to complete the project, and accounts for days on which the contractor is unable to work due to seasonal or weather limitations.

The construction procurement process specifies the number of working days or the dates for completion and has a documented set of policies and procedures for determining working days and monitoring contractors' compliance. Changes to working days or the specified dates of completion are established by change order.

2. Construction Cost

To manage construction budgets, the Cabinet establishes an overall construction authority for each project. This construction authority includes the cost of construction engineering (these are the costs of Cabinet labor performing construction inspection and other quality assurance work) and a contingency that provides for change orders and payment for any incentive provisions. Outside of the procurement process, the Cabinet can only manage construction cost through change order management and the use of its own engineering labor. The use of Cabinet labor for construction and materials quality assurance is recorded as construction engineering and is typically budgeted at 10 percent of the construction amount.

3. Construction Engineering and Management

The Cabinet performs construction engineering through its district offices. In total, some 546 positions are dedicated to construction engineering. These positions are resident engineers and construction inspectors who ensure that projects are built according to the construction specifications and requirements. As part of construction engineering, the Cabinet does materials testing and other oversight work aimed at ensuring quality through adherence to the materials specifications. There are some 152 positions involved in materials testing. Construction inspection and associated quality assurance practices were not evaluated as part of this review.

4. About Change Orders

Generally, the construction industry recognizes that it is unrealistic to expect a construction project to be built without deviation from the project plans. It is important to note that good construction management practices include change orders to improve on plans and address omissions. In general, however, change orders that affect construction costs are not subject to competitive low bid but are negotiated; therefore, they can have higher unit costs than low bid costs. Change orders can increase, decrease, or have no impact on the total amount paid to a contractor.

Although projects should be built from high-quality designs, conditions change and these changes cannot always be addressed during design. Unforeseen site conditions, utility conflicts, and changes in the geology can arise during construction. Only the

construction engineer is in a position to judge the adequacy of project design and respond to needed changes.

5. Change Order Approval Authority

The Cabinet defines a change order as follows: "A written order issued by the Engineer to the contractor, covering changes in the plans or quantities or both, within the scope of the contract and establishing the basis of payment and time adjustments for the work affected by the changes" (*Construction Manual*, Chapter 63-02, Section 2-15). Supplemental agreements, meanwhile, are defined by the Cabinet as follows: "A written agreement executed by the Contractor and the Commissioner, with the consent of the surety when required, covering major changes and/or revised or new unit prices and times, and supplementing the original contract" (*Construction Manual*, Chapter 63-02, Section 2-15). Although change orders deal with issues within the original project scope, and supplemental agreements are used for out of scope issues, the Cabinet uses the same forms and procedures for both.

The section of the Cabinet's *Construction Manual* that addresses business rules for change orders, Chapter 63-02.1000, was last updated in September 1992. This section of the manual has been superseded by the only other documented source of business rules for change orders, Construction Memo No. 1-02, dated January 7, 2002. Therefore, we must base our description of the Cabinet's written procedures about change orders on both these documents, despite the fact that the Construction Manual is clearly out-of-date.

Construction Memo No. 1-02 was written by the Director of the Division of Construction, and addressed to Chief District Engineers, Transportation Engineering Branch Managers for Construction, District Construction Engineers, Resident Engineers, and Active Consultant Engineers. In this one-page document, he notes: "In the upcoming season, the Cabinet will face some severe financial challenges." As part of its efforts to meet those financial challenges, the Cabinet moved at that time to reverse the sequence of approvals for its change order process.

Until that time, the first steps in the change order process were to obtain signatures and approval for a change order and then have the Cabinet encumber the necessary funds. This Construction Memo required this sequence to be reversed. Under the new rules, the resident engineer seeking approval for a change order must "first…check with the necessary parties, such as the District Transportation Engineering Branch manager, the Central Office Liaison, and the fund manager for the project to verify that the project is both needed and affordable. If we don't have the money, we can't do the change order, no matter how much value it would add to the project."

Under this new rule, the resident engineer continues to obtain sign off on the "Request for Project Funding Modification Form" generated by the Contractor Payment Estimate System. At the same time, the Resident Engineer's authority to approve change orders below a $25,000 threshold was revoked and replaced with a process in which all change

orders, regardless of dollar magnitude, must be approved by the Commissioner or the Deputy State Highway Engineer for Construction and Operations.

B. Question 1: What is the magnitude and cause of change orders?

There is a need for factual information regarding the number and magnitude of change orders on construction projects in recent years.

1. Answer

The Kentucky Transportation Cabinet incurred 986 change orders on all projects completed in fiscal years 2002 and 2003 at a total cost of $56,692,315. However, half the value of these change orders occurred on just 89 of the 662 projects. The Cabinet does not maintain information documenting the cause of change orders; therefore, it is not possible to evaluate the causes of change orders across all the projects.

2. Analysis Strategy

- A data set comprising all projects completed in fiscal years 2002 and 2003 was analyzed. Analysis was restricted to completed projects so that it was possible to evaluate the proportion of a final project's value that change orders accounted for.
- To provide an overview of current practices, change orders were analyzed by size, type of work, geographical distribution, and contractor's state of incorporation.
- Change orders were also analyzed by project type and geographical distribution to determine any pattern that suggests a type of project or district that deviates from the average.

3. Findings

- **Change orders amounted to $56.7 million or 2.7 percent by value of all construction projects completed in fiscal years 2002 and 2003.**

  Summary data on change orders for all projects completed in fiscal years 2002 and 2003 are presented in Exhibit VII-1.

Exhibit VII-1: Number and Value of Change Orders by Project Type (all projects completed fiscal years 2002 and 2003)

Project Type	Change Orders		Percent of Award Amount	Awarded Amount ($)
	Number	Value ($)		
Highway Reconstruction/Modernization	226	27,172,250	2.7	1,025,050,076
Bridge Reconstruction/ Modernization	89	3,544,135	2.8	125,952,980
Bridge Preservation	101	3,463,037	2.0	169,158,867
Pavement Preservation	455	20,348,506	2.8	720,137,394
Other	115	2,164,386	4.7	45,990,274
Total	**986**	**$56,692,315**	**2.7%**	**$2,086,289,591**

Source: Contractor Payment Estimate System

In total, the change orders for the past two fiscal years amount to over $56 million, which is 2.7 percent of the value of all projects completed. This represents a relatively low rate of change orders.

- **Change orders are heavily concentrated on a relatively few projects.**

  Exhibit VII-2 shows the distribution of the value of change orders according to their value as a percentage of award amounts. For example, the exhibit shows that for 167 projects, change orders amounted to less than 1 percent of the contract value. However, for 89 projects, change orders amounted to over 20 percent of contract value and these change orders in total accounted for approximately 60 percent of the value of change orders.

Exhibit VII-2: Value of Change Orders as a Percentage of Award Amount by Number of Projects and Value of Change Orders

Value of Change Orders (percent of award amount)	Number of Projects	Total Value	Change Order Value ($)	Percentage of Total Change Order Value
<1	167	92,990,123	354,615	0.6
1 ≤ 2.5	102	96,942,821	1,619,705	2.7
2.5 ≤ 5	99	61,771,350	2,262,295	3.7
5 ≤ 10	95	113,881,834	9,076,580	14.9
10 ≤ 20	110	121,000,880	17,627,544	28.9
≥ 20	89	75,106,704	29,971,626	49.2
			Total	**100%**

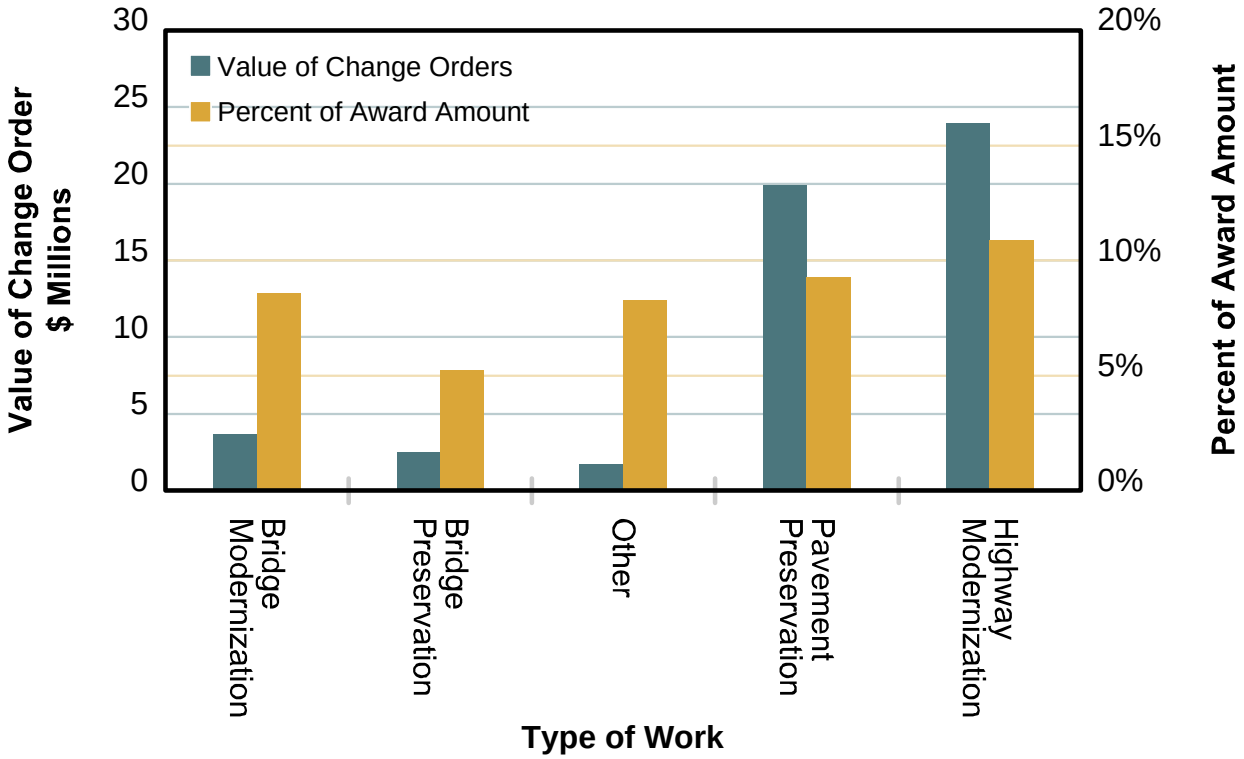
Source: Kentucky Transportation Cabinet Contractor Payment Estimate System.

Insofar as the Cabinet can identify those change orders that do not provide increased value or that could be avoided through more complete plans, cost savings can be yielded.

- **Change orders are most prevalent on projects that are primarily pavement preservation.**

  Exhibit VII-3 clearly shows the number and value of change orders by work type. Change orders for highway modernization and pavement preservation account for 84 percent of the total change order expenditures.

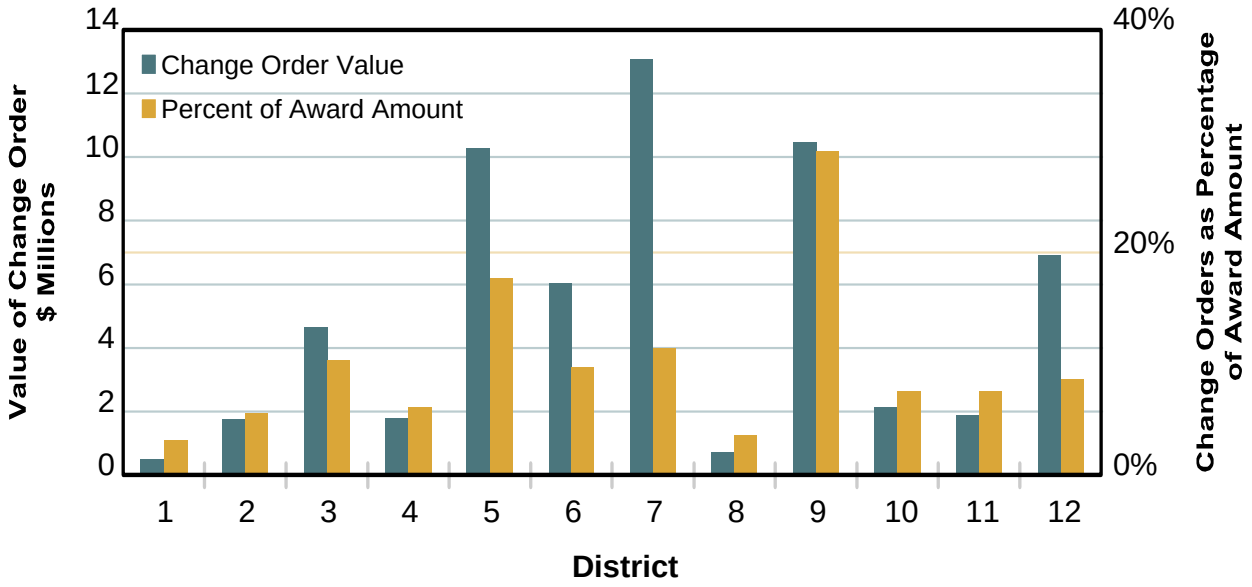
Exhibit VII-3: Value of Change Orders and Percent of Award Amount by Type of Work (construction projects completed FY2002 and 2003)



- **The dollar value of change orders has been most heavily concentrated in Districts 5, 7, and 9[1]. The numbers of change orders are fairly evenly distributed across the state.**

  While analysis indicates that the number of change orders are fairly evenly distributed across the state, the value of change orders are concentrated as depicted in Exhibit VII-4.

Exhibit VII-4: Value of Change Orders and Concentration of Change by District



- **There is no significant statistical relationship between the number of change orders and the engineer's estimate.**

  Statistical analysis across all projects found no evidence to indicate a pattern of very low bids with normal rates of profit being secured through change orders. However, our analysis did identify a small number of projects that were awarded substantially below the engineer's estimate that then had very high levels of change orders. These projects can be identified in Exhibit VII-5.

  As further background on projects with high change order values, Exhibit VII-5 lists each of these projects by district and shows their project award amount compared to the engineer's estimate.

[1] District 5 – includes Bullitt, Franklin, Henry, Jefferson, Oldham, Shelby, Spencer, and Trimble counties.
District 7 – includes Anderson, Bourbon, Boyle, Clark, Fayette, Garrard, Jessamine, Madison, Mercer, Montgomery, Scott, and Woodford counties.
District 9 – includes Bath, Boyd, Carter, Elliott, Fleming, Greenup, Lewis, Mason, Nicholas, and Rowan counties.

Exhibit VII-5: Projects with the Largest Change Order Value

Project No.[a]	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
10460	4	379,969	293.5	129,464	8	1
10398	9	239,962	197.8	121,322	-13	3
20287	2	143,490	151.0	95,051	-4	1
10445	2	33,145	127.3	26,030	-54	3
20309	10	724,758	124.5	581,922	-32	8
20289	5	32,557	120.2	27,088	-75	2
10144	4	50,676	116.2	43,600	-26	4
10180	9	2,787,322	102.3	2,725,385	-9	1
20146	4	69,418	100.0	69,418	-25	3
20073	4	25,114	100.0	25,114	-56	6
10363	12	5,934	97.9	6,060	-48	4
10204	7	163,984	97.7	167,857	-1	6
10583	6	61,472	65.3	94,113	-57	4
10682	7	31,196	59.8	52,140	7	6
10727	3	451,867	58.4	773,835	-59	5
10823	3	127,223	55.4	229,483	-24	5
10407	7	157,095	54.4	288,565	-27	3
20400	5	447,938	52.9	846,022	-15	4
10213	7	35,012	51.4	68,134	-68	4
10096	12	298,158	51.1	583,434	-2	1
10613	2	68,298	49.7	137,553	-12	3
10241	12	2,381,833	46.4	5,138,078	4	1
10758	5	494,407	45.9	1,076,000	-38	3
10216	11	17,000	45.8	37,135	-55	1
20709	11	65,606	45.8	143,182	-62	4
20280	5	221,590	45.6	486,166	-38	4
20178	7	32,807	44.5	73,800	9	1
10418	2	275,197	43.6	630,795	-26	2
20292	9	5,944,976	43.2	13,746,411	2	1
10517	7	1,706,209	42.9	3,974,993	-12	1
10503	5	349,192	42.1	829,800	-21	3
10611	6	161,886	41.8	387,622	-30	3
10330	12	231,405	40.6	569,943	4	1
10738	1	58,410	40.4	144,625	-12	1
10101	11	21,280	39.9	53,379	-48	6

Project No.[a]	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
10335	4	26,981	39.5	68,287	-38	2
10540	11	101,080	39.1	258,834	-52	2
20533	5	85,000	38.6	220,400	-15	2
20735	2	55,181	37.3	148,108	6	4
20410	6	59,292	36.9	160,847	-11	1
19003	5	250,871	36.3	691,412	98	3
10521	8	17,084	35.9	47,609	-17	3
20256	10	27,660	35.5	77,911	-138	9
20298	8	111,649	35.4	315,627	-23	8
10755	9	575,633	34.9	1,651,600	-8	8
20663	2	16,868	34.3	49,158	-12	6
10579	6	164,514	34.2	481,579	-31	3
20506	12	13,500	33.7	40,062	22	7
30187	6	47,545	33.2	143,331	15	4
10396	7	39,726	32.7	121,628	-5	2
20638	6	107,210	32.5	330,178	72	1
20118	6	38,170	32.3	118,320	-37	3
10528	9	26,796	32.3	83,049	-19	4
30487	3	200,966	31.5	638,958	6	1
10773	12	82,150	31.0	264,624	-23	2
10593	5	6,360,706	30.4	20,943,000	15	2
10514	12	4,500	30.2	14,921	12	4
30217	6	47,346	30.0	157,756	-9	4
10615	3	37,133	29.9	124,039	-4	1
Total		**$26,793,943**		**$61,534,755**		

[a] Appendix A provides a narrative description of each project.

Source: Kentucky Transportation Cabinet Contractor Payment Estimate System.

C. Question 2: Does the Transportation Cabinet have effective management controls and procedures for change order management?

There have been concerns that construction projects have been subject to a high number of change orders. Among the issues of concern are:

- Whether the appropriate management controls are in place.

- Allegations that contractors will make a low bid and then achieve a normal profit level through change orders.
- Projects are advertised and let before they are completely ready; that is, they are not biddable or buildable. This is a design quality issue.

1. Answer

The Cabinet has experienced low rates of change orders on many projects; however, there has been a significant concentration of change orders on a relatively few projects. The current change order process provides control, but is cumbersome and impacts effective project financial management and project quality management.

2. Findings

- **It is entirely appropriate that change orders occur on construction projects provided that there are effective management and control procedures.**

  There is no correct answer to the question of what is the appropriate level of change orders. Change orders can be used to correct design errors and omissions, address unforeseen situations, improve methods, and allow for contractor identified changes to work scheduling that reduce costs.

- **The Kentucky Transportation Cabinet does not maintain information documenting the cause of change orders and change order record keeping is generally weak.**

  We have conducted a quantitative analysis of some 986 change orders covering a broad spectrum of items over the past two fiscal years. Reviewing this data makes it clear that there are no standardized business rules for naming standard items. In practice, there is considerable variation. Interview results also indicate that the change order work can be completed before the change order is approved.

- **The need exists for a stronger link between preconstruction and construction for change order and scope management.**

  In the Cabinet's business practices, change order decision-making is managed within construction. There is no control mechanism which allows the Preconstruction Project Manager of Six-Year Highway Plan projects or the Operations Manager of resurfacing and safety projects to review and approve change orders. This creates scope management risk because projects can be changed in the field, which, in turn, changes their purpose and scope from that originally planned.

  The second risk is that change orders due to quality problems in design are not relayed back to design, or decisions made in preconstruction regarding specifications or other matters are not communicated. Discussions with the Chief District Engineers, Construction Branch Manager, and Resident Engineers suggested some of the change orders could have been avoided by improved design

work (especially having consultants do more geotechnical work). There may be a correlation between the Pre-Construction Project Manager's span of control and the quality of the deliverable, the ability to monitor the consultant, etc.

- **Interviewees in the districts expressed concern that the Kentucky Transportation Cabinet faces risks due to the limited experience of some Resident Engineers and the shortages of construction inspectors.**

  Interviewees reported that in some districts large construction contracts, $30 million and above, are being managed by Resident Engineers with limited experience. This may delay the early identification of problems and is compounded when experienced personnel are not able to get to the site. Others expressed concern that shortages of construction inspectors are increasing project risks with respect to change order management, quality, cost, and safety.

D. Question 3: Is construction delivered on schedule and within budget?

The timely completion of construction reduces costs and increases the economic benefits to highway system users. The key issue for construction is whether contractors are held accountable to the schedule in their contracts and whether construction is delivered within budget.

1. Answer

Yes, in aggregate, construction projects are completed within the contract schedule and on budget. In total, some 95 percent of projects are either completed on schedule or early. This represents a significant improvement between 1996 and 2001. With regard to cost management, the analysis of change orders reported found that overall the rate of change orders was not high but that a minority of projects experienced unusually high change order amounts.

While the analysis results indicate that construction is completed on schedule and within budget, it is important to note that this performance is measured against the agreed schedule and budget. The review did not determine if there are opportunities to reduce construction time and, if so, whether it would be cost-effective. Further, our inability to establish metrics for measuring construction engineering cost as a percentage of construction expenditures indicates that management has not been engaged in active, program-level budget oversight.

2. Analysis Strategy

A data set comprised of all construction projects, both those in the Six-Year Highway Plan and other state funded construction projects completed in the past two fiscal years, was analyzed. This provided a sample of 1,075 projects for which schedule performance

data was derived from the Contractor Pay Estimate System and expenditure data obtained from the accounting system (MARS).

Construction schedule performance was measured using the following indicators:

- Whether projects were completed within the original number of work days. The difference can include time due to change orders.
- Whether projects were completed within the specified date of completion.

The original analysis plan was to evaluate expenditures on construction engineering and assess them as a proportion of construction costs, while disaggregating construction engineering from total expenditures in the budget analysis. We understand this information can now be developed from all construction projects started in Fiscal Year 2003, but it was not possible to obtain the data to analyze projects completed in the past two fiscal years.

Given the data constraints, construction budget performance is evaluated by measuring final construction expenditures, including comparing payments to contractors and construction engineering with the construction authorization.

3. Findings

- **Overall construction is performed on schedule.**

  Of 933 projects, 95 percent were completed by their specified completion date. Of the 88 projects that had a specified number of work days, 55 percent were completed on schedule or early, and 45 percent were completed late. Exhibit VII-6 details construction schedule performance. These results indicate the Cabinet is performing well in managing the vast majority of construction projects to ensure timely completion.

Exhibit VII-6: Construction Schedule Performance

Schedule Delay Profile	Projects to be Completed in a Certain Number of Work Days		Projects to be Completed by a Certain Completion Date	
	Number	Percentage	Number	Percentage
Projects on Schedule	9	10.2	741	75.1
Total Projects Completed Early	39	44.3	192	19.5
Total Projects Completed Late	40	45.5	54	5.5
Less than 1 month late	34	38.6	32	3.2
1 to 2 months late	5	5.7	7	0.7
2 to 4 months late	1	1.1	10	1.0
Over 4 months late	0	0.0	5	0.5
Total	**88**	**100.0%**	**987**	**100.0%**

Source: Kentucky Transportation Cabinet Contractor Pay Estimate System.

- **The Transportation Cabinet has strengthened the management of construction schedules.**

  The Cabinet's data bases do not readily enable the monitoring and reporting of whether construction is completed on schedule. The findings reported in this review indicate that performance has improved since the late 1990s. Prior analysis reported in the Cabinet's 2001 performance report[2] finds that from 1996 to 2001:

  – Approximately 40 percent of construction projects required more work days than the original contract called for.

  – Approximately 20 percent of projects required more work days than the original number of work days including those with approved adjustments established through change orders.

  – Approximately 20 percent of projects were completed after their contractually specified completion date.

  These data do not provide any information on the magnitude of these delays in completing projects. However, every day a project is not open to traffic incurs a cost to the highway user because the capital asset (the highway) is not being used.

[2] *The Path*, Kentucky Transportation Cabinet 2001 Year End Report.

- **Construction projects are in aggregate delivered 2.6 percent under the authorized construction cost.**

  Analysis of a sample of 777 projects completed between 1998 and August 2003 found that, in total, they were completed at a cost 2.6 percent less than the authorized construction cost. This indicates at the construction authorization level a budget underrun of $71 million on $2.68 billion of construction as shown in Exhibit VII-7.

Exhibit VII-7: Construction Authorization Compared to Actual Expenditure

Construction Budgeting Process	Number	Authorization Amount ($M)	Expenditure ($M)	Variance ($)	Percentage
Over Budget (20%+)	111	181	319	(138)	6.56
Over Budget (10-20%)	84	373	423	(49)	13.56
On Budget (+/- 10%)	460	1,655	1,635	20	60.07
Under Budget (10-20%)	54	183	156	27	6.63
Under Budget (20%+)	68	363	152	211	13.19
	777	**$2,755**	**$2,684**	**71**	**2.56**

Source: Kentucky Transportation Cabinet Contractor Pay Estimate System and MARS system.

The construction authorization is based on estimated contractor costs and 10 percent for construction engineering, plus a 10 percent contingency. The inability to isolate data on construction engineering expenditures limited a more detailed analysis of construction budget management.

- **The inability to report construction engineering as percentage of construction costs by project indicates little management attention to project financial management.**

  Because it has not been possible to isolate construction engineering expenditures on projects, it would be very difficult to manage construction engineering budgets. There is simply no access to the data. To successfully manage a construction budget, obtaining this type of information must be made a priority.

- **The Transportation Cabinet has needed to use liquidated damages sparingly to hold contractors accountable for schedule performance.**

  The principal way the Cabinet can hold contractors accountable for meeting the contracted schedule is to charge liquidated damages. Construction work has been completed on time; therefore, there has been little need to enforce liquidated damages provisions. The provisions in most construction contracts enable the

Cabinet to collect liquidated damages when a contractor has exceeded the contracted schedule. Since Fiscal Year 1999, however, liquidated damages of only $21,860 have been collected on 14 projects out of $1 billion plus of construction contracts.

Liquidated damages apply only to those delays for which time extensions have not been negotiated between the Cabinet and the contractor and codified in change orders. The written policies and business rules around liquidated damages are contained in Division One, Section 108.09 of the Cabinet's *Standard Specifications for Road and Bridge Construction*, last updated in 2000. This subsection is entitled "Failure to Complete on Time." Daily charges not to exceed the schedule listed in Exhibit VII-8 below may be applied as specified in the contract, except as negotiated in special circumstances.

Exhibit VII-8: Schedule for Liquidated Damages

Original Contract Amount ($)		Daily Charge ($)
(From)	(To and including)	
0.00	100,000	150
100,000.01	5,000,000	200
500,000.01	1,000,000	300
1,000,000.01	2,000,000	400
2,000,000.01	5,000,000	600
5,000,000.01	10,000,000	800
10,000,000.01	20,000,000	1,600
20,000,000.01	Or more	3,000

Source: Kentucky Transportation Cabinet, Standard Specifications for Road and Bridge Construction, January 1, 2000.

Interviewees reported that the Cabinet tries to avoid collecting liquidated damages because the process is contentious and time-consuming in terms of documentation, approvals, and contractor appeals. The Cabinet works with contractors to expedite and complete work without imposing liquidated damages as long as the contractor has a work force on site and is progressing at a reasonable rate.

If the same contractor is working on multiple Cabinet projects, the Cabinet will usually work with the contractor to prioritize those projects. The Cabinet is most likely to pursue liquidated damages when the contractor simply abandons the project (however temporarily) in order to work on a non-Cabinet job.

E. Question 4: Does the Transportation Cabinet apply the appropriate level of resources to construction engineering?

Construction engineering is one of the most critical functions of the Cabinet. It oversees the expenditure of funds to ensure that construction projects are built to specification and to high quality. The issue analyzed is whether the Cabinet's construction engineering expenditures are comparable to those of other states. In addition, some district interviewees expressed concern that a shortage of construction inspectors is increasing project risk with respect to quality.

1. Answer

It was not possible to develop quantitative information from which to answer this question.

There are 546 positions with construction engineering responsibilities distributed across headquarters and the 12 districts as of November 12, 2003. Construction engineering is a critical function because it directly oversees the expenditure of construction dollars. The lack of data from which to evaluate resources applied to construction engineering provides a strong indication that the Cabinet has not been engaged in the active program level management of construction engineering resources.

2. Analysis Strategy

- Assessed whether data could be used to evaluate actual construction engineering expenditures. This was not possible due to the limitations of the Cabinet's reporting systems.
- Evaluated the number of positions assigned to construction engineering.
- Evaluated the time that construction employees charged to projects. The analysis assumption is that if there are too many employees, or if they are in the wrong place, there will be less time charged to projects and more to overhead categories. Conversely, overtime would suggest the shortage of resources.

3. Background

There is a well-defined chain of command and responsibility for construction projects, with construction engineering performed through the district office. The Division of Construction is headed by a Director who is responsible to the Assistant State Highway Engineer for Construction on all matters relating to contract administration and project construction. The Division of Construction is responsible for administering contracted highway construction from award until the project is completed and the contractor is paid in full, including checking and verification of final estimates. The Cabinet has 12 district offices located throughout the state. Each district office is

headed by a Chief District Engineer who is responsible for all activities in the district. The Chief District Engineer reports directly to the State Highway Engineer.

The number of construction engineering positions in the Districts ranges from 32 in District 10 to 62 in District 7. This excludes management such as the District Engineer and the District Transportation Engineering Branch Manager. Construction management is performed through the following functions:

- Each district has a District Transportation Engineering Branch Manager for Construction who is directly responsible, through the Chief District Engineer, to the Department of Highways Commissioner or State Highway Engineer. The District Transportation Engineering Branch Manager for Construction is assisted by a District Materials Engineer who has charge on all matters relating to the materials used in construction projects and a District Construction Engineer who has direct charge of the highway construction.
- Operating under the general supervision of the District Construction Engineer is the Project Engineer, who is the Department's representative. Personnel are assigned to the Project Engineer to assist in staking and inspecting projects. The inspector has the authority and responsibility to enforce the specifications. If any methods are used that will impair the quality of the finished work, the inspector shall immediately advise the contractor's representative and his superior. The inspector is authorized and obligated to reject any "out of spec" material and work.

4. Findings

- **It appears that the Transportation Cabinet does not perform active program level resource management for construction engineering resources.**

  The inability to obtain information on construction engineering expenditures strongly indicates that management does not actively perform project resource management for the construction engineering and material labor applied to program delivery. This is because it is not possible to readily determine whether the Cabinet applies the right amount of labor resources and management has not typically assembled this type of information.

- **While interviewees indicated that positions are hard to fill, analysis indicates that in November 2003 there were only 10 unfilled positions out of 500.**

  There were few unfilled positions in construction engineering and these are fairly evenly distributed across the different districts. In fiscal year 2003, overtime equivalent to 3.5 full time employees was paid to construction engineering employees and an equivalent amount in compensatory time was accrued.

F. Recommendations

1. Recommendation VII-1: Establish a procedure for reporting change orders by cause.

A procedure should be developed for reporting change orders by cause. This can most easily be done by establishing a "cause of change order" variable within the Contractor Payment Estimate System. The results should be tabulated to provide trend information to better manage change orders and provide feedback from construction to design regarding design quality issues.

2. Recommendation VII-2: Establish new management controls and procedures regarding change order review and approval to strengthen scope and quality management.

The intent of this recommendation is for the Cabinet to revise the business rules and approval process for change orders to involve the Preconstruction Project Manager or project owner. (As part of implementation, these individuals on the different types of projects will need to be defined.) The role of the Preconstruction Project Manager or project owner should at a minimum include concurrence with the need for the change order. This will help address scope management; it will also provide feedback regarding quality because issues unresolved during design will be brought to the Project Manager's attention.

3. Recommendation VII-3: Revise the change order approval process to reduce approval time, and strengthen project financial management by ensuring that funds are encumbered in a timely fashion.

This recommendation addresses the current situation in which change order work can be completed before it has passed through the entire approval process. Our understanding is that, because a number of approval layers are effectively a rubber stamp, work under change orders frequently begins before approval of the change orders. This recommendation also addresses a significant financial management challenge in a fiscally constrained environment: namely, the delay between approving work (expenditures) in the field and encumbering funds in the financial management system. This delay prevents the Cabinet from having a true picture of its cash position and introduces financial risk. In implementing the recommendation, it is critical that the new process not increase the time it takes for approval because that is not efficient. The new process should be supported by an automated electronic change order approval process that supports the reporting of change orders by type and cause as recommended in Item 1 above. There should be a control so that funds are encumbered upon change order approval.

4. Recommendation VII-4: Evaluate practices used to establish construction schedules and identify opportunities to shorten them without reducing quality.

The intent of this recommendation is to enable the Cabinet to build on its success in having construction completed on time by determining whether it is possible to raise the bar and establish tighter timelines for construction. Implementing the recommendation involves identifying which types of construction projects it is desirable to have completed more quickly and then determining whether this can be accomplished. The evaluation should determine whether the current approach establishes appropriate construction schedules. Benefits from shorter construction durations arise because disruption to traffic, which can increase journey times and result in work zone accidents is reduced. Broader economic benefits to tax payers arise because the taxes that they pay are more quickly put into productive use as improved roadways.

5. Recommendation VII-5: Establish, track, and report on construction project schedule and budget performance at major milestones.

This recommendation should be implemented in conjunction with the overall recommendations for improving project delivery management, reporting, and accountability. (These areas are addressed in the recommendations in Section V.) The intent is to establish a standardized metric that Cabinet management can use to provide management oversight and tracking across all construction projects. This information is not currently tracked and reported. Technology improvements that are underway and detailed in Sections VIII and IX can facilitate this.

6. Recommendation VII-6: Manage construction engineering work load and resource allocation across districts.

The purpose of this recommendation is to establish construction engineering budgets at the program level and allow the Cabinet to manage to these budgets. The intent is to provide resource loading across projects and districts to balance work load. This is to ensure that, as construction work levels fluctuate between districts, resources are most effectively used. The starting point should be to establish work standards and apply them to projected construction workload by district.

VIII. Review of Accounting and Management Information Systems

■

This section reviews the Kentucky Transportation Cabinet's accounting and other major information technology systems (with the exception of systems specifically related to project information which are described in further detail in Section IX). This section includes an assessment of the various application systems and how well they meet the needs of the General Assembly, external entities, and the Cabinet for timely information. This section also includes a benchmarking of the Cabinet's application systems against best practices.

The questions evaluated are:

- **Question 1:** Do the Transportation Cabinet's existing financial and other management systems properly capture and provide for ease of access to summary level data and reports desired by the General Assembly and other external entities?
- **Question 2:** Do the Transportation Cabinet's existing financial and other management systems properly capture and provide access to summary and/or detailed information required by Cabinet staff to effectively manage the day-to-day operations of the Cabinet?
- **Question 3:** How do the Transportation Cabinet's accounting and other information technology management systems compare with those of other transportation agencies nationally?

A. Background

The Cabinet is a data and analysis intensive organization. The business of building, maintaining, and operating the highway system is supported by a complex set of related information systems. For purposes of this analysis, the Cabinet's key management systems are divided into the following categories:

- Accounting and Financial Management.
- Planning Programming and Project Development.
- Contract Procurement and Estimating.
- Construction Management.
- Operations and Maintenance Management.

The analysis in this section will focus on two of these categories: the Accounting and Financial Management systems and the Operations and Maintenance Management systems. These two systems and applications are summarized below. (Additional background is provided in Appendix C.) Section IX focuses on those systems providing

information from project identification through project completion, including the Planning, Programming and Project Development, Contract Procurement and Estimating, and Construction Management categories.

1. Accounting and Financial Management

The Accounting and Financial Management accounting systems and other financial reporting and management tools support the capturing and analysis of Cabinet financial information. The key components are summarized in Exhibit VIII-1 below.

Exhibit VIII-1: Key Components of Accounting and Financial Management Applications

Application	Business Function	Technology
Management Administrative Reporting System (MARS)		
• Advantage	Primary statewide accounting system. Functionality includes General Ledger, Revenue Accounting, Accounts Receivable, Accounts Payable, Fixed Assets, Inventory Control, Project Accounting and Billing, Cost Accounting, Federal Aid and other grants management and Federal Aid Billing to the Federal Highway Administration's (FHWA) Federal Management Information System (FMIS) module.	Mainframe, DB2 based application adapted from a package solution offered by American Management Systems.
• Procurement Desktop	Statewide Procurement system utilized by the Cabinet for purchases other than highway contracts.	Oracle based package application from American Management Systems.
• Budget Reporting and Analysis Support	Supports budget formulation, review, publishing, and monitoring.	Oracle based solution provided by American Management Systems.
• Management Reporting Database	Data warehouse which integrates data from Advantage and Procurement Desktop in a common dataset for standardized and ad hoc reporting. A number of the Cabinet staff use this application for financial analysis and reporting.	Oracle based application.
• SeaGate Report Suite	Set of predefined custom reports which utilize data in the Management Reporting database.	Developed utilizing SeaGate Corporation's Crystal Report Writer toolkit.
• Project Authorization System	Utilized to authorize new projects or initiate changes to authorized funding levels for existing projects within the Cabinet.	Mainframe.
• Cash Forecasting	Support cash flow forecasting and analysis.	Series of Microsoft Excel based spreadsheet models.

2. Operations and Maintenance Management

This category includes management systems which both support the ongoing management of the assets of the transportation infrastructure as well as aid in selecting potential projects. Systems in this category include Maintenance Management, Equipment Management, Pavement Management, Bridge Management, and Safety Management. The Cabinet's major current or planned applications in this area are summarized in Exhibit VIII-2 below.

Exhibit VIII-2: Key Components of Operations and Maintenance Management Applications

Application	Business Function	Technology
Operations Management System		
• Maintenance Management	Captures a record of all maintenance activities performed by the Cabinet, including what work was done, who did it, what material was used, what equipment was used, how long the work took, and how much it cost.	Adaptation of TRDI's Maintenance Manager application, which is an Oracle based package solution.
• Equipment Management	Supports management of equipment and fleet including forecasting equipment life, tracking maintenance costs, determining wear-out rates, and scheduling routine maintenance.	Adaptation of TRDI's Equipment Manager application, which is an Oracle based package solution.
• Pavement Management (deployment pending, in testing)	Stores, retrieves, and processes user-defined, pavement-related condition and inventory data in order to analyze current conditions, predict future performance, and determine the expected needs of the pavement network.	Adaptation of TRDI's Pavement Manager application, which is an Oracle based package solution.
• Bridge Management (deployment pending, in development)	Uses bridge condition and inventory data to effectively allocate funds to deteriorating, obsolete, or substandard bridges. The flexible bridge management framework stores, retrieves, and processes bridge condition and inventory data, and allows for analysis of the current condition and needs of the bridge population for a wide range of circumstances.	Adaptation of TRDI's Bridge Manager application, which is an Oracle based package solution.

Application	Business Function	Technology
• Highway Inventory System	Inventory of the physical features of the roadway network.	The current Highway Inventory System application is an adaptation of Oracle Highways, a commercially available software package. Since the Cabinet initially implemented the Highway Inventory System, Oracle Corporation sold this software package to Exor Corporation, which has continued to provide maintenance, enhancements, and support for the product. Currently, the Cabinet is in the process of upgrading the Highway Inventory System to the new release of Exor Highways.
• Kentucky Bridge Inventory System	Contains information on the structure and conditions of bridges within the Commonwealth based on biannual inspections of almost every structural element of every bridge in the state.	Custom developed, mainframe application.
• Kentucky Pavement Management System	Maintains information on pavement condition and allows for analysis of current condition and prediction of future performance. This application is targeted to be replaced by the Pavement Management module of the Operations Management System during 2004.	Custom developed, mainframe based Fortran application.
• Collision Report Analysis for Safer Highways	Provides collision reports from all law enforcement agencies across Kentucky.	Custom developed, Oracle-based application.
• Safety Management Analysis Tools	Analytical tools to help in identifying and analyzing safety candidate locations.	Custom developed tools utilizing data extracted from the Collision Report Analysis application.
• Accident Manager (licensed by the Cabinet but deployment pending. Still in development and testing, with deployment plans being reassessed)	Provides collision information and analysis tools to identify safety candidate locations and priorities. Application has been licensed by the Cabinet for some time, but several implementation issues have been encountered.	Module of Exor Highways, which is an Oracle-based package application.

B. Question 1: Do the Transportation Cabinet's existing financial and other management systems properly capture and provide easy access to summary level data and reports desired by the General Assembly and other external entities?

There is a concern that the financial and other management information provided by the Kentucky Transportation Cabinet to external entities is difficult to compile and not as timely and accurate as possible.

1. Answer

Yes, for the most part, the Cabinet's existing financial and other management systems accurately capture information in a form usable by the General Assembly and other external entities. Cabinet staff is quickly able to create most reports requested by the General Assembly or respond to other ad hoc requests. The most significant barrier to improved management reporting in the Cabinet is not the information systems but the leadership's not establishing a consistent set of reports and metrics to manage the overall business of the agency and provide proactive accountability to the General Assembly.

A principal challenge faced by the Cabinet information systems is to allow easy access to the General Assembly staff or other outside staffs. Cabinet staff are often unfamiliar with the data models and data integration of their application systems, even those that have access.

2. Analysis Strategy

Our analysis approach included the following steps:

- Evaluation of existing systems documentation.
- Review of product information or other available documentation about functionality of current or planned systems.
- Interviews with Cabinet business owners for key systems to determine flexibility in responding to information requests from the General Assembly and others.
- Interviews with Legislative Research Commission staff to better understand types of requests made by the Legislative Research Commission to the Cabinet.

3. Findings

Findings as to the ease of access to and the accuracy of the financial and other information for the General Assembly and other external entities are provided below. For ease of presentation, these findings have been broken down by Financial Management and Operations and Maintenance Management.

a. Financial Management

- **The Kentucky Transportation Cabinet's financial management systems properly capture and provide for ease of access to summary level data and reports desired by the General Assembly and other external entities. However, the Cabinet's financial management systems do not easily allow for ad hoc reporting or analysis by General Assembly or other non-Cabinet staff.**

  The flexibility of the Management Reporting Database allows Cabinet staff to prepare financial reports and analyses and respond to ad hoc requests fairly quickly. In addition, because the Management Reporting Database is on the same platform (an Oracle database) as other databases, this simplifies linking to other Cabinet datasets such as the Six-Year Highway Plan database or the Operations Management System.

  Cabinet staff is currently providing monthly cash forecasting summaries to the General Assembly and others. These summary reports are generated with limited manipulation from the Excel based cash forecasting models being used by the Cabinet.

  There is no data dictionary for the Management Reporting Database or other Cabinet applications; therefore, it would be difficult, for non-Cabinet personnel such as Legislative Research Commission staff to develop reports from the Management Reporting Database. In fact, within the Cabinet itself, it can be difficult for staff who are not familiar with or who do not work with the Management Reporting Database regularly to obtain information if it is not available from a standard report within the SeaGate reports suite.

b. Operations and Maintenance Management

- **The Kentucky Transportation Cabinet's operations and maintenance management systems properly capture and provide for ease of access to summary level data and reports desired by the General Assembly and other external entities.**

  The flexibility of the Operations Management System, as well as the data integration which will be possible between the Maintenance, Equipment, Bridge, and Pavement modules within the Operations Management System when the modules are fully implemented, should enable Cabinet staff to respond to requests from the General Assembly for information about maintenance activities and expenditures and equipment usage and costs.

  The Cabinet can also provide the General Assembly or other interested parties considerable information on pavement condition ratings, the impact of investments in pavement rehabilitation, and other trade-off analysis from its existing Kentucky Pavement Management system.

- **Management information reporting capabilities will be further strengthened by the implementation of the TRDI Bridge Manager and Pavement Manager modules as part of the Operations Management System.**

  The current implementation will enable the Cabinet to provide more pavement management and bridge management information as the Cabinet's analytical tools become more fully functional through implementing the new Pavement Management module of the Operations Management System and the new Bridge Management application within the Operations Management System.

- **LRC staff has access to the Highway Inventory System.**

  The Cabinet currently provides the Legislative Research Commission Transportation staff with access to the Highway Inventory System. The Legislative Research Commission Transportation staff makes extensive use of this application in performing their daily activities.

C. Question 2: Do the Transportation Cabinet's existing financial and other management systems properly capture and provide for access to summary and/or detailed information required by Cabinet staff to effectively manage the day-to-day operations of the Cabinet?

There is a concern that the lack of easy access to and the lack of high quality financial and other management information available to Cabinet staff may be an impediment to making the management decisions needed for the day-to-day operations of the Cabinet.

1. Answer

Yes, for the most part, the Cabinet's existing financial and other management systems accurately capture information for easy access by Cabinet management and staff for the ongoing operation of the Cabinet. Knowledgeable Cabinet staff are generally able to create requested reports. However, staff not familiar with the data models and data integration of the Cabinet's applications have difficulty obtaining information. In practice, managers are highly dependent for reports on a small number of staff familiar with the data design of various applications.

Although the Cabinet is implementing a series of off-the-shelf operational and maintenance management applications, not all of these are fully operational. Thus some tools for analyzing current conditions and conducting network and project level trade-off analysis are missing. The most significant is a fully functional bridge management system.

2. Analysis Strategy

Our analytical approach for addressing this question included the following steps:

- Evaluation of existing systems documentation.
- Review of product information or other documentation about the functionality of systems currently in development or planned for implementation.
- Interviews with Cabinet business owners of key systems.
- Interviews with other Cabinet staff in the central office and Districts 5,7,11, and 12 to assess flexibility of current systems in providing information for operational decisions.

3. Findings

Findings as to the accuracy of and ease of access to financial and other information by Cabinet staff for management decision-making is provided below. For ease of presentation, these findings have been broken down into Financial Management and Operations and Maintenance Management.

a. Financial Management

- **The Kentucky Transportation Cabinet's financial management systems, for the most part, properly capture and provide for access to summary and/or detailed information required by staff to effectively manage day-to-day operations.**

  As is the case with external requests, the flexibility of the Management Reporting Database, along with the predefined SeaGate reports and the cash forecasting models, allows staff to quickly prepare regular financial reports and respond to ad hoc requests from other staff members within the Cabinet.

  All managers, from Branch Managers upward, are provided access to the monthly budget status report. Typically, it is the division directors or, in the case of highway districts, the engineering branch managers who use these reports to track budget status. These reports can be summarized at different organizational levels to meet the needs of different management levels (e.g. account level for a division director, department/office level for a commissioner/office head, location level for a highway district or a statewide program such as highway maintenance). Examples of reports contained in the monthly report include: summary level budget to actual by fund, budget status by program area (for example maintenance, design, right of way, etc.) at a summary level or at a district or county level, life to date budget status for projects at a summary level, and summary level cash management status reports.

One recent example of an ad hoc report request from Cabinet management was a detailed analysis of Road Fund expenditures over the past several fiscal years. This complex request required both knowledge of the Cabinet's business practices and the underlying financial data. This analysis determined the percentage of funds expended by project phase (design, right of way, utilities, and construction) as well as the amount paid to vendors versus in-house costs. This report was required to answer questions from the vendor community regarding project expenditures for preconstruction and construction work on highway projects.

A second, less complicated example of an ad hoc report request is the routine use of the Management Reporting Database to analyze revenue collections, expenditure patterns, and the related variances from projections to update cash forecasting models.

The Cabinet's fiscal and budget staff routinely use the Management Reporting Database for gathering ad hoc information. It provides more extensive access and much more flexibility for data mining and manipulation. In addition, as noted above, because the Management Reporting Database is an Oracle database, this simplifies linking to other Cabinet datasets such as the Six-Year Highway Plan or the Operations Management System. More frequent information requests are normally developed as standard reports through Crystal Report Writer and included in the SeaGate report set.

Prior work with transportation agencies in other states has revealed concerns about how well statewide accounting systems meet the needs of transportation agencies since most state agencies use administrative budgeting while state transportation agencies are primarily project based. These types of concerns about the statewide system's support for the unique needs of the transportation agency did not surface during our analysis the Cabinet. This is probably due to a number of factors including (1) the extensive involvement of Cabinet Fiscal staff in the initial definition of requirements and in the selection of the American Management System (AMS) software and (2) the relative maturity of the implementation, allowing time for most major issues to surface and be addressed.

- **The most important gaps in management reporting include the inability to track detailed transactions at the project level, the requirements for dual record keeping on project authorizations between the Project Authorization System and MARS, and the difficulty for non-Fiscal or non-Budget staff to perform ad hoc reporting or analysis on the financial information.**

  In discussions with Cabinet fiscal staff and other managers and staff across the organization, few significant gaps or enhancement requirements in

terms of accounting or financial management system functionality were identified. Four exceptions to this rule are identified below:

- The requirement to provide easier access to detailed transaction information at the project level. A project manager wanting information about one or more detailed transactions charged against a project will normally need assistance from staff more familiar with the Management Reporting Database. Based on our interviews, this is usually a very time-consuming process for the project manager.
- The Preconstruction Status functionality of the Six-Year Highway Plan application, for example, shows actual charges at the project level by major category (design, right of way, utilities, and construction) but not transaction level detail. A monthly report displays all Cabinet accounting transaction detail and can be accessed using the query and filtering tools in the SeaGate report suite. However, project managers reported this tool as not being easy to use (especially if used infrequently).
- The requirement to streamline the project authorization process and eliminate the duplicate entry into the Project Authorization System and MARS by integrating MARS with a new functionality replacing the Project Authorization System.
- Difficulty in performing ad hoc analysis. Because there is no data dictionary in the Management Reporting Database or other applications, some Cabinet personnel have difficulty in developing reports from the Management Reporting Database (in situations where a report in the SeaGate report suite does not meet the need). Cabinet staff must depend upon a small group with detailed knowledge of the Management Reporting Database to obtain information and perform some analysis.

b. Operations and Maintenance Management

- **Operations and maintenance management systems support management decision-making.**

  The Cabinet's operations and maintenance management systems, for the most part, properly capture and provide for access to summary and/or detailed information required to effectively manage the day-to-day operations of the Cabinet. One exception is the lack of a fully functional Bridge Management system. However, the Cabinet is currently implementing TRDI's Bridge Manager as part of the Operations Management System.

  The Operations Management System provides the ability to track maintenance work activity at a detailed level. Because the Operations Management System uses a standard cost versus the actual payroll costs captured in MARS, there may be slight differences between the Operations

Management System and the Management Reporting Database. The cost for a maintenance worker to operate a mower on overtime would be captured in MARS at the overtime rate, while the Operations Management System would capture a standard cost because it does not know if the mowing was done during the normal work day or on overtime. Instead, the Operations Management System only records what work was done, where it was performed, and the total hours of what labor were required. To date, the Cabinet has not found this inconsistency between MARS and the Operations Management System to have had a material impact.

The Highway Inventory System provides a single repository for capturing and recording roadway attributes and features. Its capabilities will be enhanced by the upgrade to the new Exor Highways application which will link the Highway Inventory System and the Geographic Information System and reduce the need to update highway inventory information in two places.

The Kentucky Pavement Management System provides an appropriate level of detailed information and analysis on pavement conditions and allows for analyzing investments and trade-offs in pavement rehabilitation. This functionality will be enhanced by implementing the Pavement Management module of the Operations Management System. This new module will provide tighter integration with the Maintenance Management application because they share a common database.

While the Collision Report Analysis for Safer Highways application is only a repository for crash information and does not provide any analytical capabilities, and the Accident Manager module has not been successfully implemented within the Highway Inventory System to date, the safety management analysis tools developed by the Cabinet and the University of Kentucky Transportation Center provide appropriate capabilities for identifying and analyzing candidate locations for safety projects.

- **The Transportation Cabinet has work underway to improve bridge management information.**

  The existing Kentucky Bridge Inventory System is only a repository of bridge inventory and condition information and does not provide the analysis capabilities typically expected of bridge management systems. The Kentucky Bridge Information System, for example, neither supports analysis of networkwide preservation and improvement policies for evaluating the needs of each bridge in a network nor provides the capability to recommend projects to include in the transportation program. It does not allow for trade-off analysis between ongoing maintenance and or replacement of a particular structure. These activities must be performed manually by members of the Operations staff using information in the Kentucky Bridge Inventory System.

The analytical functionality generally expected of a bridge management system should be available to the Cabinet following implementation of TRDI's Bridge Manager as a component of the Operations Management System.

D. Question 3: How do the Transportation Cabinet's accounting and other information technology management systems compare with those of other transportation agencies nationally?

There is an interest in understanding how the Cabinet's accounting and other management systems compare with those of other transportation agencies nationally and whether there are opportunities to learn from what other agencies are doing to help improve the overall quality of the Cabinet's management systems.

1. Answer

The Cabinet's accounting, financial management, and other operational management systems compare favorably with those of other transportation agencies nationally. MARS and its associated Management Reporting Database provide an appropriate level of detailed financial information. In addition, the Cabinet has adopted Oracle as its standard platform and is migrating new custom-developed applications to this platform. Likewise, the Cabinet is migrating to more off-the-shelf applications where possible (i.e., the Operations Management System, Highway Inventory System, etc.) to replace custom applications. In general, these package applications chosen by the Cabinet are market leaders or among the market leaders in each of their specialized application areas.

The Cabinet, like other transportation agencies, faces a challenge in integrating various engineering and financial systems that were developed independently. By standardizing on one database platform and adopting suites of software where possible such as the Highway Information System and the Operations Management System, the Cabinet is taking significant steps to efficiently integrate and provide enterprise level management information.

The Cabinet does have the opportunity to strengthen application areas that lag behind those of other states by implementing a bridge management system and by pursuing tighter integration between the bridge, pavement, safety, and highway inventory applications and between these applications and the geographic information system.

2. Analysis Strategy

Our analysis approach for addressing this question included the following steps:

- Evaluation of existing systems documentation.

- Review and comparison of Cabinet applications with best practice information derived from other Dye Management Group, Inc studies.
- Follow-up discussions with staff at other transportation agencies and/or vendors as appropriate.

3. Findings

How the Cabinet's financial and other management information systems compare with those of other transportation agencies is provided below. These findings have been broken down into general findings and a set of findings for the Financial Management and Operations and Maintenance Management system groupings.

a. General

- **The Kentucky Transportation Cabinet, like a number of state transportation agencies, has established Oracle as a common database architecture and is migrating a number of its self-developed systems to market-leading off-the-shelf software solutions.**

  The Cabinet has, or is replacing, several old legacy custom applications (for example, the mainframe Maintenance Management system and the mainframe Kentucky Pavement Management system) with commercially available off-the-shelf software. In most cases, the software selected is among the market leaders in its particular application area. Adoption of these off-the-shelf software solutions should allow the Cabinet to lower overall cost of ownership and reduce the complexity of its application portfolio.

  As many transportation agencies across the nation have done, the Cabinet has established Oracle as its target enterprise database platform. The Cabinet has consistently selected packages such as the Operations Management System and the Highway Inventory System which operate on the Oracle platform and is developing new in-house applications when absolutely required for the Oracle platform.

  Standardizing Oracle as a common platform allows the Cabinet to take advantage of the large amount of packaged software developed for the Oracle environment and should reduce the amount of custom development going forward. In addition, using Oracle as a common platform for most of the critical management systems should help to facilitate tighter integration between various application systems.

b. Financial Management

- **The Kentucky Transportation Cabinet's financial management systems have functionality and reporting capability comparable to most states.**

The Cabinet's financial management applications provide functionality similar to that available in other state transportation agencies. And, unlike some transportation agencies, this functionality is provided by a common statewide accounting system, thus reducing the overall cost of ownership for the Commonwealth and the Cabinet of maintaining a separate transportation agency financial system.

The MARS application suite is an adaptation of American Management Systems financial software. American Management Systems is a leading software vendor for state and large local governments and its Advantage suite is currently used at various versions and release levels as a primary statewide financial system in approximately 20 states, including Colorado, Illinois, Missouri, and Utah.

A number of state transportation agencies have their own financial systems, which are integrated (usually at the general ledger level) with the statewide systems. Initially, most state departments of transportation with their own systems had custom developed applications (as the Cabinet did until 1992). Recently, however, some state departments of transportation have adopted and customized commercial off-the-shelf software solutions. The Virginia Department of Transportation (VDOT) implemented Peoplesoft in 1998 and the North Carolina Department of Transportation (NCDOT) implemented SAP in the spring of 2003. Both of these department level implementation projects were extremely expensive, multiyear implementation efforts. In its most recent report to North Carolina's Information Management Resource Commission, for example, NCDOT has projected a final cost for its BISP initiative of over $50 million, including business process analysis and re-design efforts, software licensing, customization, hardware and training, and initial deployment.

c. Operations and Maintenance Management

A number of Best Practices findings and observations in the Operations and Maintenance Management area are provided below.

(1) Maintenance and Equipment Management

- **The Maintenance and Equipment modules of the Operations Management System, based on TRDI's software suite, appear to be very competitive with other commercially available solutions.**

  The Maintenance and Equipment modules of the Cabinet's Operations Management System application is based on TRDI's Maintenance Manager and Equipment Manager products. Subsequent to the selection of these products by Kentucky, NCDOT also selected Maintenance Manager as the base for re-implementing their

Maintenance Management System. Likewise, the Montana Department of Transportation uses TRDI's Equipment Manager module.

TRDI's provides one of several package solutions for maintenance and equipment management which are actively being marketed to and adopted by transportation agencies. Two other solutions reviewed as part of this study include:

- **Highway Maintenance Management System – Booz-Allen Hamilton.**

  Various generations or versions of this application have been implemented by state transportation agencies in Georgia, New Hampshire, New Mexico, New York, and Vermont. The Tennessee Department of Transportation is currently implementing the application. In the earliest implementations (New Hampshire, Vermont, and others), there was significant customization of the core application package to meet agency requirements.

- **Asset Management/CMMS–Hansen Information Technologies, Inc.**

  This application has been implemented by CalTrans and meets about 85 percent of California's needs, with custom extensions required to meet the state's remaining requirements.

When TRDI's offering has been adopted for the Operations Management System, it appears to be very competitive from a function and feature standpoint with other solutions. In terms of Maintenance Management, TRDI's solution can capture and track all maintenance activities at an appropriate level of detail and provides predictive analysis for determining budget requirements to meet a particular level of service. In terms of Equipment Management, TRDI's Equipment Manager provides the same functionality found in other leading equipment management packages, including the capability to forecast equipment life, track maintenance costs, determine wear-out rates, schedule routine maintenance, and track parts inventory and turnover.

(2) Highway Inventory

- **The Highway Inventory System compares favorably to other inventory systems.**

  The Highway Inventory System, based on Exor's Highways software suite, appears to be very competitive from a function and feature and architectural perspective with other commercially available or custom-developed solutions. Some highway inventory systems in other

transportation agencies have a tighter linkage with the transportation agency's geographic information system. The Cabinet is addressing this gap through its upgrading of the Highway Inventory System to the newest release of Exor's Highways product.

Exor's Highways suite, the basis of the Highway Inventory System, is a leading package highway inventory solution. Other transportation agencies using Exor Highways as part of their roadway inventory solutions include the Indiana, Kansas, Maine and Virginia Departments of Transportation and the British Columbia Ministry of Transportation.

A number of other states have developed their own roadway inventory applications and associated analysis tools. Two examples include:

- Oklahoma Department of Transportation's Geographical Resource Intranet Portal (GRIP), which includes roadway inventory and bridge inventory, accident history, current projects, and construction history in a geographic information system-based application.
- Mississippi Department of Transportation's Transportation Management Information System, which provides roadway inventory and sign inventory, pavement and bridge management, accident history, and relevant financial information in a common database integrated through the geographic information system.

Both the Oklahoma and Mississippi applications are notable for the tight integration between the application software and the agency's geographic information system. The Cabinet is expecting to achieve this level of enhanced integration through its planned upgrade of the Highway Information System following the next release of Exor's Highways product.

A second important characteristic of these applications is the tracking and integration of roadside features (such as the sign inventory and video logging included in the Transportation Management Information System). This level of data collection has not been done to date by the Cabinet. Likewise, a third notable feature of these applications is the effort to make these tools more of a business warehouse or enterprise framework through integration of project history and financial information. Incorporation of this type of information allows an agency staff member to select a segment on the transportation network through the geographic information system and ask questions such as:

- What does the road surface look like now?

- Are there any projects planned/programmed or in progress on this road segment?
- What projects have been performed on this segment or adjoining segments in the past?

(3) Pavement Management

- **When fully implemented, the pavement management module of the Operations Management System should provide the Kentucky Transportation Cabinet with similar functionality to that found in pavement management systems used by other state transportation agencies.**

  TRDI's Pavement Manager product, which is being implemented as the Pavement Management module of the Operations Management System, has been developed based on years of pavement management and engineering experience by TRDI staff. TRDI has worked with Brazil on a project which defined the international pavement management methodology adopted by the World Bank and provided technical assistance and management services for a number of years to support the Strategic Highway Research Program (SHRP) in the development and conduct of Long-Term Pavement Performance (LTPP) studies. Other state transportation agencies which are currently using predecessors to, or earlier versions of, TRDI's Pavement Manager application include Pennsylvania, Montana, and Oregon. TRDI's Pavement Manager is also used by the Quebec Ministry of Transportation.

  The TRDI Pavement Manager application appears to provide similar functionality as to other pavement management applications used by state transportation agencies. One of the competitive solutions analyzed at a high level by our team for this report is Deighton Associates dTIMS CT (the newest version is being renamed dTAMS) asset management solution. The dTIMS CT is currently used by 17 state transportation agencies, including Colorado, Iowa, Indiana, Missouri, Arkansas, and Louisiana. Both dTIMS CT and TRDI Pavement Manager appear to have a number of similar features and functions including network optimization, network scenario analysis, pavement performance analysis, and project life cycle cost analysis.

(4) Bridge Management

- **Unlike most other state transportation agencies, the Kentucky Transportation Cabinet does not have a fully functional bridge management system.**

The Cabinet is planning to address this gap through the use of TRDI's Bridge Manager software. While TRDI's Bridge Manager appears to have similar functionality to AASHTO's Pontis, the presumed industry standard, TRDI Bridge Manager has not yet been implemented by another state transportation agency in the United States.

Most state transportation agencies (38 as of 2002 according to AASHTO) have adopted AASHTO's PontisTM application, part of AASHTO's BRIDGEwareTM suite, to perform the bridge management function. Pontis stores bridge inventory and inspection data, supports formulation of networkwide preservation and improvement policies for use in evaluating the needs of each bridge in a network, and makes recommendations for what projects to include in the transportation program. Pontis also provides a systematic procedure for the allocation of resources to the preservation and improvement of the bridges in a network. Pontis accomplishes this by comparing costs and benefits of maintenance to investments in improvements or replacements.

The TRDI Bridge Manager module appears on the surface to have the same functionality as the Pontis application and may have some added flexibility in configuring some system components such as user-defined performance criteria, modeling features, decision trees, analysis scenarios, and user-defined reporting. Three of the primary designers of TRDI's Bridge Manager, Stuart Hudson, Len Moser, and Dr. Ronald Hudson, were also part of the National Cooperative Highway Research Program (NCHRP) study which resulted in the incubation of Pontis. However, at this time, there are only two other implementations of Bridge Manager or earlier predecessor versions of the application: the Peru Ministry of Transportation and the Trinidad Ministry of Works and Transport. No other state transportation agencies are utilizing the TRDI Bridge Manager software application.

(5) Safety Management

- **The Safety Management Analysis tools developed for the Kentucky Transportation Cabinet by the University of Kentucky Transportation Center provide similar functionality for identification and analysis of safety projects as those being developed by the FHWA, AASHTO, and other states.**

  In order to bench mark the capabilities of the Cabinet's safety management analysis software, the project team reviewed at a high level the functionality in three safety management applications currently in various stages of development. These three applications were:

  – The FHWA's Office of Safety Research and Development's Interactive Highway Safety Design Model, which initially focuses

on two-lane rural highways. This application consists of several modules including crash prediction software that estimates the number and severity of crashes on specified roadway segments, a design consistency tool that evaluates the operating speed consistency along a roadway, and intersection review tools which provide a structured process for evaluating the safety impact of intersection design alternatives using an expert system approach.

- The Transportation Safety Management Information System, which is being developed by AASHTO, in conjunction with FHWA, to analyze crash data within a common data warehouse structure.

- The Mississippi Department of Transportation's (MDOT) Safety Analysis Management System being planned to significantly extend the safety analysis of MDOT's TMIS application, its existing geographic information system-based data warehouse. One key function of this planned System will be the capability to relate the geographic information system data to the road system including rumble strips, guard rails, traffic volumes, signage, pavement conditions, bridge conditions, lighting, pavement markings, and traffic control devices. Another key feature will be intersection analysis, including breakdowns by various attributes and information plotted on "Intersection Magic" or other similar diagramming software. Other analysis capabilities will include intersection analysis with a defined adjustable distance radius, linear analysis plotted by log mile and number of crashes/crash types on a given route, and straight line diagramming using all relevant linear referencing system (LRS) elements.

The breadth and depth of the safety analysis tools incorporated in these three applications is, for the most part, similar to those developed by the University of Kentucky Transportation Center for the Cabinet. The primary difference is that AASHTO has a consolidated, structured, data warehouse or repository and MDOT tightly integrates its Analysis Management System with the geographic information system. The current Cabinet approach is to extract information from the Collision Report Analysis for Safer Highways application and interface it to Highway Inventory System and geographic information system data.

E. Recommendations

1. Recommendation VIII-1: Develop a data dictionary for key Kentucky Transportation Cabinet information from the Management Reporting Database and other management systems.

Development of a data dictionary for key Cabinet information in the Management Reporting Database and other key management systems such as the Operations Management System will allow users to more quickly respond to ad hoc report requests from the General Assembly and other external entities. This data dictionary will also allow a greater range of Cabinet staff to access information in the Management Reporting Database and other systems for internal management analysis purposes. In addition, at the discretion of the Transportation Cabinet, the Legislative Research Commission staff, and other appropriate Commonwealth staff could be given access to Cabinet applications for query and reporting purposes, with the data dictionary serving as the critical tool for accessing these applications.

As an adjunct to this recommendation, depending on the volume of ad hoc queries being developed, it may be appropriate to create reporting snapshots on a nightly or other basis of key Cabinet datasets to minimize the impact of reporting activities on transaction processing. The Management Reporting Database is already a snapshot of data from the MARS, Advantage, and Procurement Desktop applications.

2. Recommendation VIII-2: Develop a detailed project charges report for use by Project Managers and other staff requiring access to detailed information.

This recommendation involves developing a monthly report from the Management Reporting Database which itemizes the specific type, amount, and cost of all items charged to a project during a given period. This would include staff time and external costs such as payments to engineering consultants and contractors. This report should show total charges before the period, total activity during the period which ties to the items presented on the report, and total charges as of the end of the period. This report should contain subtotals by major category which ties to the information presented as of that period in the preconstruction status functionality of the Six-Year Highway Plan Application.

Given the emphasis on project managers' having tighter control of projects and better estimating charges to projects, this proposed report would be a valuable tool in helping them understand the costs charged to their projects. This understanding would allow for quicker identification of problems now and would improve estimates of project costs (both total cost to complete a project and monthly cash expenditures) going forward.

3. Recommendation VIII-3: Continue adoption of off-the-shelf systems and standardization on the Oracle platform to the extent possible.

This recommendation calls for a continuation of the current direction towards standardizing on the Oracle database platform and using off-the-shelf software to the extent possible. Using off-the-shelf software reduces the Cabinet's overall cost of ownership and allows organizational emphasis to be placed on other core missions without the need to develop and support software applications. Relying on off-the-shelf software is becoming easier to do as a result of the increased flexibility built-in to commercial software designed for the mass market, the development of more targeted commercial offerings for the transportation community such as TRDI's suite or Exor's Highways product, and the depth of functionality available in some of AASHTO's joint development offerings.

Continued standardization on the Oracle database platform will help facilitate the use of off-the-shelf software since many, if not most, software applications are developed on or targeted for the Oracle platform. In addition, standardization on one database platform will help to facilitate data level integration of various application systems (such as the Management Reporting Database, the Operations Management System, and the Highway Inventory System).

4. Recommendation VIII-4: Complete planned migration and upgrade projects designed to enhance Pavement Management and Highway Inventory functionality.

The Cabinet should complete the migration of the pavement management functionality to the TRDI Pavement Manager module within the Operations Management System. The TRDI Pavement Manager module is currently in parallel testing.

The benefits of completing the production deployment of TRDI Pavement Manager as part of the Operations Management System include:

- Opportunity to decommission the existing legacy mainframe Pavement Management application and migrate functionality to an Oracle-based, off-the-shelf software component.
- Potential to achieve tighter integration between the Maintenance Management and Pavement Management applications since both applications will be part of the same suite within the Operations Management System.
- Potential to more tightly integrate the Pavement Management system with the Highway Inventory System. since they will share a common database platform.

The Kentucky Transportation Cabinet should complete the upgrade of the Highway Inventory System following the new release of Exor Highways. Completion of this upgrade will allow the Cabinet to begin tighter integration between the Highway

Inventory System and the geographic information system and help the move towards a more integrated data analysis environment such as currently if found in other state transportation agencies including those of Mississippi and Oklahoma.

5. Recommendation VIII-5: Continue implementation of a fully functional Bridge Management System.

The Cabinet does not currently have a fully functioning Bridge Management (BMS) system. Bridge management network and trade-off analysis is currently performed manually. Given the recommended focus (please refer to Section III) on having a more data-driven project selection process, it is important that this gap be addressed immediately.

The Cabinet has licensed the TRDI Bridge Manager module for inclusion in the Operations Management System application and has contracted with the University of Kentucky Transportation Center for implementation support. Implementation is targeted for completion over the next three years.

While TRDI Bridge Manager (unlike the more widely used Pontis application) has no existing track record in other United States transportation agencies, it appears to provide the base line functionality expected of an industry standard bridge management system and considerable effort has already been invested by the Cabinet in preparing for its implementation. The Cabinet should move forward with its implementation, even exploring opportunities to expedite the implementation schedule.

In addition, as part of this implementation effort, additional focus should be placed on the role and purpose of the Kentucky Bridge Inventory System and the Structures Manager module of Exor Highways in maintaining bridge inventory information to minimize the need for redundant data between these different systems. The Cabinet should explore, for example, whether making Exor's Structures Manager part of the Highway Inventory System could provide most of the functionality currently provided by the Kentucky Bridge Inventory system. This would allow the in-house supported Kentucky Bridge Inventory System to be decommissioned and could provide for tighter integration between the Structures Manager component of the Highway Information System and the Bridge Management application in the Operations Management System, since they would both be operating on the Oracle platform.

IX. Project Management Information Reporting Capabilities

This section reviews the Kentucky Transportation Cabinet's project management information reporting capabilities, including an assessment of the availability of timely and accurate project information for project managers, senior managers, the General Assembly, and other external entities. The Cabinet's project information capabilities are compared to best practices in other transportation agencies. In addition, recommendations for improvement in reporting project management information are identified.

The questions evaluated are:

- **Question 1:** Does the Transportation Cabinet's existing project management and control systems provide project managers with the appropriate tools and information to effectively manage projects during both preconstruction and construction?
- **Question 2:** Does the Transportation Cabinet's existing project management and control systems provide Transportation Cabinet senior management and program managers with appropriate and timely information about project status?
- **Question 3:** Does the Transportation Cabinet's existing project management and control systems provide external parties (General Assembly, county or local officials, the general public, and others) with appropriate and timely information about project status?
- **Question 4:** How do the Transportation Cabinet's project management and control systems and ease of reporting project status both internally and externally compare with those of other transportation agencies nationally?

A. Background

For purposes of this analysis, the Cabinet's key management systems can be divided into the following categories:

- Accounting and Financial Management.
- Planning, Programming, and Project Development.
- Contract Procurement and Estimating.
- Construction Management.
- Operations and Maintenance Management.

The analysis in this section will focus on systems or applications which specifically capture, track, and report on project information from project identification through project completion. The analysis includes applications in the Planning, Programming, and Project Development, Contract Procurement and Estimating, and Construction Management categories. The systems and applications in each of these three categories are summarized below. Additional background on these application systems is provided in Appendix C.

An assessment of the Cabinet's accounting and other management systems (the systems in the Accounting and Financial Management and Operations and Maintenance Management categories) is contained in Section VIII.

1. Planning, Programming, and Project Development

This category includes all management systems which support the planning, programming, and preconstruction from project conception through planning and design to letting. The major applications in this area are described in Exhibit IX-1 below.

Exhibit IX-1: Planning, Programming and Project Development Applications

Application	Business Function	Technology
Six-Year Highway Plan Application	Manages the creation and publication of the Six-Year Highway Plan. It also provides extensive project tracking and project information for active projects, especially in the Pre-Construction phase.	Custom developed Oracle database based application
Unscheduled Needs List	A list of potential projects not currently scheduled in the Six-Year Highway Plan.	Custom developed Dbase application maintained by Division of Planning, with some reporting capabilities from Microsoft Access and Microsoft Excel.
Gold File	Tracks requests for transportation projects sent to the Secretary of Transportation and the State Highway Engineer to consider for inclusion in the Six-Year Highway Plan application.	Custom developed Oracle database based application.

Application	Business Function	Technology
LRC Dataset	Monthly extract created by the Kentucky Transportation Cabinet and provided to the Legislative Research Commission. It is created from information in the Six-Year Highway Plan application, Project Authorization System, and Contractor Pay Estimate System applications and provides a snapshot of project financial and schedule status for Six-Year Highway Plan and other Kentucky Transportation Cabinet projects.	Custom Microsoft Access database developed through extracting information from multiple systems.
Right of Way and Utilities	Provides detailed tracking of right of way status at the parcel level within a project.	Custom developed Oracle database based application.

2. Contract Procurement and Estimating

Contract procurement and estimating includes all management systems which support the highway construction contract procurement process including preparation of Cabinet engineer's estimate by the Cost Estimating unit, development of the bid and proposal package, receipt of bids from contractors, the analysis of bids received, and the actual awarding of a contract. The major applications in this area are summarized in Exhibit IX-2 below.

Exhibit IX-2: Contract Procurement and Estimating Applications

Application	Business Function	Technology
PQ Manager	Manages and tracks prequalification of highway contractors.	Custom developed, Clarion based mainframe application.
Win-Bid	Assists with preparation of the Preliminary Specification and Estimating package; also utilized by Contract Procurement to create and publish proposal bid items.	Custom developed, Clarion based mainframe application.
Bid Letting Management System	Supports and assists with management of the bid letting process.	Custom developed, Clarion based mainframe application.
HighwayBid	Helps to create the engineers' estimate. It is also used to create a bid file which is returned by contractors on a diskette at the time of bid submission.	Custom developed, Clarion based mainframe application.

Application	Business Function	Technology
Bid Reader	Used by the Office of Technology to process contractor bids received through HighwayBid application.	Custom developed, Clarion based mainframe application.
BidPublisher	Used by Contract Procurement to publish bids on the internet during and after the letting.	Custom developed, Clarion based mainframe application
BidTabs	Used by Contract Procurement to tabulate and analyze bids.	Custom developed, FORTRAN based mainframe application
AASHTO BAMS/DSS	Historical database of bid activity which provides decision support and analysis capabilities in the areas of bid monitoring and evaluation, vendor and market analysis, and item price estimation.	Oracle based package solution provided by American Association of State Highway Transportation Officials.

3. Construction Management

Construction Management includes management systems which support project construction, including maintaining the assigned project inspector's daily work reports and other project records, preparation and processing of the contractor's periodic pay estimate, management of change orders, and the tracking of materials testing. The major Cabinet applications in this area are summarized in Exhibit IX-3 below.

Exhibit IX-3: Construction Management Applications

Application	Business Function	Technology
Contractor Pay Estimate System	Processes construction contractor pay estimates and manages and tracks construction contract change orders.	Custom developed application. It consists of Clarion based components on the mainframe and DOS based components.
Kentucky Construction Engineering Program	Field record keeping system used by construction staff. It tracks daily work activities by construction contractors and is the primary source for information used to create the periodic construction contractor pay estimates.	PC based application.
Kentucky Materials Management Information System	Tracks many of the materials testing activities performed by the Materials Lab.	Oracle based application.

Application	Business Function	Technology
AASHTO Trns*port SiteManager	Provides construction record keeping, contractor pay estimate, change order tracking, materials testing and other construction management functionality. Intended to replace the custom Contractor Pay Estimate System and the Kentucky Construction Engineering Program. May also replace the Kentucky Materials Management Information System.	Oracle based package solution provided by American Association of State Highway Transportation Officials.

B. Question 1: Do the Transportation Cabinet's existing project management and control systems provide project managers with the appropriate tools and information to effectively manage projects during both preconstruction and construction?

There is a concern that the Cabinet's existing project management and control systems may not provide project managers with all of the tools and information required to effectively manage projects during both preconstruction and construction.

1. Answer

No. While the preconstruction status reporting functionality of the Six-Year Highway Plan application does provide the Cabinet's project managers with considerable capability to track key milestone dates for preconstruction and monitor the summary status of various activities such as right of way and utilities, Cabinet project managers do not have easy access to the details required for project schedule and project budget management. The Cabinet's project managers do not have the capability to create, manage, or monitor a project schedule. Likewise, while Cabinet project managers have access to considerable summary level information, the tools available to them do not easily provide the ability to drill down to identify and manage exceptions. During the construction phase, while there are systems in place to perform project record keeping and process contractor's estimates, there is no roll-up of summary project status information or tracking of key milestone dates within the project tracking functions of the Six-Year Highway Plan application.

2. Analysis Strategy

Our analysis approach included the following steps:

- Evaluation of existing systems documentation.

- Review of product information or other available documentation about functionality of systems currently in development or planned for implementation.
- Interviews with Cabinet business owners for key systems to better understand system capabilities.
- Interviews with Cabinet project managers in Districts 5, 7, 11, and 12 to help better assess the fit of these systems in meeting the project manager's information requirements.

3. Findings

- **For the preconstruction phase, the Six-Year Highway Plan application provides a reasonable level of project tracking.**

  The preconstruction status system part of the Six-Year Highway Plan application is very robust and provides project managers with a great deal of detailed project tracking and status information for preconstruction activities. This system includes a predefined set of key milestone dates and an audit trail of revisions to these dates. It also includes information on expenditures to date by major category (design, right of way, utilities, and construction), information on expenditures against amounts budgeted and encumbered, and summary information on the status of permits, right of way, and utilities.

- **During the construction phase of the Six-Year Highway Plan application there is limited project tracking capability.**

  The Six-Year Highway Plan application contains limited information for the construction phases. While it does track expenditures for the construction phase through a link to the Management Reporting Database application, it does not track critical milestone dates for the construction phase. The last milestone date in the Six-Year Highway Plan application appears to be for the letting date. Thus, there is no umbrella project tracking capability across phases nor is there any functionality to provide management reporting and accountability regarding key milestone dates during construction or to analyze the extent to which projects in the construction phase may have missed certain milestones such as the originally scheduled open-to-traffic date.

- **Project Managers do not have easy access to detailed level financial information.**

  Financial information in the Six-Year Highway Plan application is presented to project managers at the summary level by category only. It is difficult to see detailed transaction level charges against a project. There is a monthly report that displays all accounting transaction detail for the Cabinet so that users can use the query and filtering tools in Seagate to access data unique to their areas of interest. Project managers reported that this tool is not easy to use (especially if used infrequently) and indicate that getting detailed project financial level information

normally requires assistance from administrative staff in the districts or fiscal staff in the Central Office.

- **Project Managers do not have access to a project scheduling tool.**

  The preconstruction status reporting function in the Six-Year Highway Plan application is only a project tracking function. It is not a project scheduling tool. There are currently no tools available for Cabinet project managers to develop a detailed critical path milestone project schedule. In addition, except for some of the very large projects, these types of schedules are not necessarily required from consulting firms for preconstruction activities.

- **Right of way specialists have considerable detailed tracking capability and project managers have summary information on right of way activities available to them. However, the Kentucky Transportation Cabinet project managers do not have any drill down capability to easily identify and monitor right of way exceptions.**

  The right of way and utility system provides considerable functionality and solid tracking capabilities down to the parcel level. In addition, there is now an automated link between the right of way and utility system and the Six-Year Highway Plan application to provide project managers with up-to-date summary information. However, the Six-Year Highway Plan application does not help the project manager focus on managing by exception. For example, the Six-Year Highway Plan application will tell the project manager that right of way clearance has been achieved for 25 of 30 parcels on a particular project but it does not give the project manager a way to link to the right of way and utility application to quickly see which parcels do not have clearance and/or which parcels may not have clearance by the planned milestone date for completing right of way acquisition.

- **There is utility summary level status information available in the Six-Year Highway Plan application, but there is no capability for project managers to drill down to a lower level of detail to identify and manage exceptions.**

  The utility functionality originally planned in the right of way and utility application has not been implemented to date and there is currently no planned implementation date. There is summary level utilities information within the preconstruction status function of the Six-Year Highway Plan application which is entered and updated by Utilities staff. Utility functionality within the Six-Year Highway Plan application includes:

  – Number of negotiations actually started out of the total number of identified utility companies affected by the proposed project.

  – Number of utilities affected by the project which have signed relocation agreements.

- Number of the utilities identified for relocation which have been relocated.
- Projected date that the identified utility action is scheduled to be completed.

However, the accuracy of this summary information is dependent on updates to the Six-Year Highway Plan application data from the utilities specialist and, as in the case of right of way, there is no exception reporting capability. The project manager can not drill down to determine, for example, which of the required relocations have not taken place or those that might not be completed by the targeted date.

C. Question 2: Do the Transportation Cabinet's existing project management and control systems provide Cabinet senior management and program managers with appropriate and timely information about project status?

There is a concern that the Cabinet's existing project management and control systems do not provide Cabinet senior management and program managers with appropriate and timely information about project status. Such information is required for program management and control, and is especially important in a fiscally constrained environment.

1. Answer

Yes, for the preconstruction phase, the Cabinet's existing project management and control systems provide Cabinet senior management and program managers access to a significant amount of detailed information to review and assess project status. This same level of detailed information is not as easily accessible for the construction phase, but access to construction phase information will be improved with the Cabinet's planned implementation of the AASHTO Trns*port SiteManager module in January 2005.

However, while there is considerable detail project level information available in the existing systems, the current systems do not readily provide snapshot information or filtering capabilities to allow District Engineers, the Deputy State Highway Engineers, or other senior managers to easily identify potential problems or issues on projects and manage by exception.

2. Analysis Strategy

Our analysis approach included the following steps:

- Evaluation of existing systems documentation.
- Review of product information or other available documentation about functionality of systems currently in development or planned for implementation.

- Interviews with Cabinet business owners for key systems to determine flexibility in responding to information requests from Cabinet management.
- Interviews with Cabinet senior managers to assess fit of existing systems in meeting their ongoing information needs

3. Findings

For ease of presentation, the findings related to the accuracy and timeliness of project information for Cabinet senior management have been divided into observations about planning and programming and project status. Each of these categories is described in detail below.

a. Planning and Programming

- **The Six-Year Highway Plan application provides considerable information about programmed projects.**

  The Six-Year Highway Plan application provides considerable detailed information for senior management and staff about projects programmed in it. Examples of information contained include the original Six-Year Highway Plan application budget estimates and current budget estimates by phase and current estimated start date by phase.

- **Information about potential projects is contained in the Gold File and Unscheduled Needs application and there is potential for duplication between these two sources.**

  Information about other potential projects which are not yet programmed is also readily available through the Gold File and the Unscheduled Needs application. Some potential projects, however, are not identified in either of these applications. In addition, there is potential for duplication between the projects in the Unscheduled Needs List and the Gold File. Likewise, the Unscheduled Needs List is a Dbase application maintained by a single employee whereas the Gold File is an Oracle application, which could be linked to the Six-Year Highway Plan application for certain reporting requirements.

b. Project Status

- **The Six-Year Highway Plan application for preconstruction and the Contractor Pay Estimate System and Kentucky Construction Engineering Program application for construction can be used for management control and some exception reporting.**

  During interviews, branch managers in the districts, district engineers, and senior staff in headquarters expressed a high level of comfort in the

accuracy and timeliness of project information they received. For the most part, however, this status is obtained as much through discussions with project managers or other staff as it is from any particular set of tools.

There is considerable detailed information at the project level available to managers if they choose to review it. The preconstruction status reporting function of the Six-Year Highway Plan application provides a reasonable level of detail information for projects in the preconstruction phase.

Similarly, the Contractor Pay Estimate System provides considerable detailed information on contractor payments and on actual quantities used on projects to date at the line item level during the construction phase. Currently, however, the information collected at the field level in the Kentucky Construction Engineering Program is posted back to the Contractor Pay Estimate System as part of the processing of contractor pay estimates (typically bi-weekly). With the implementation of the Trns*port SiteManager application, changes in project status based on the Daily Work Report could be made available to Construction Operations Branch Managers and central office staff immediately if required.

- **Senior managers have limited capability to identify or query projects based on certain performance criteria or project status to allow for managing by exception.**

  There is a limited capability for senior mangers to use automated tools to manage by exception through identifying projects as risk based on one or more metrics (including metrics which could span preconstruction and construction). The Preconstruction Status Reporting function of the Six-Year Highway Plan application has an ad hoc query capability but using this feature effectively requires a reasonable understanding of the data in the Six-Year Highway Plan application.

  Likewise, Trns*port SiteManager, when implemented, will have an ad hoc query capability for construction data. As is the case with the Six-Year Highway Plan application, the Trns*port SiteManager ad hoc query tool will require a solid understanding of the Trns*port SiteManager data model to use effectively.

D. Question 3: Do the Transportation Cabinet's existing project management and control systems provide external parties (General Assembly, county or local officials, the general public, and others) with appropriate and timely information about project status?

There is a concern that the Cabinet's existing project management and control systems make it difficult to provide external entities such as the General Assembly with appropriate and timely information about project status.

1. Answer

Yes. The project management and control systems can provide timely project status information to the General Assembly and other external parties. Technology is not a barrier to providing management accountability and proactive reporting of the Cabinet's accomplishments against stated objectives that the General Assembly seeks. The Cabinet currently provides much of this information in response to requests, but provides some information through its web site.

The Six-Year Highway Plan application is published on the Web. In addition, all approved projects are depicted on a state map by county. Reasonably detailed information is provided for projects in the preconstruction phase, but information is more limited for projects in the construction phase. Some projects have specific web sites to provide information to the public and to solicit public involvement. In addition, the Cabinet web site contains a considerable amount of detailed information on bid lettings, including the number of bidders, total of each bid, the low bidder, and the engineers estimate.

The Cabinet also provides the Legislative Research Commission (LRC) with a monthly snapshot of program and project status. This dataset contains summary status for Six-Year Highway Plan application projects in all their phases and provides a reasonable overview of the financial and schedule status of the transportation program. However, since the data set is a snapshot at the end of the previous month and is often delivered late, it does not have the ability to filter for or analyze exceptions. In the past, LRC staff have had access to the Project Authorization System, Construction Payment Estimating System, and the Six-Year Highway Plan application so they could review and analyze project status, construction contracts, and contractor payments in more detail, but this functionality is no longer available to them.

2. Analysis Strategy

Our analysis approach included the following steps:

- Evaluation of existing systems documentation.

- Review of product information or other available documentation about functionality of systems currently in development or planned for implementation.
- Review of information available on the Cabinet web sites.
- Interviews with Cabinet business owners to determine flexibility in key systems for responding to information requests from the General Assembly and others.
- Interviews with the Legislative Research Commission Transportation staff to better understand types of requests made to the Cabinet, as well as existing Cabinet resources used to research information.

3. Findings

For ease of presentation, findings in regard to this question have been categorized by information available to the public as a whole and information provided to the General Assembly. (Web shots)

a. Quality of Project Information Available to the Public

- **The current Six-Year Highway Plan application and a great deal of procurement information are on the Kentucky Transportation Cabinet web site.**

  The current Six-Year Highway Plan application has been published on the Web.

  Information on contract procurement activities and status is widely available to the contracting community and the general public through the Cabinet web site. Examples of information on the web site include:

  – Target letting dates for projects.

  – Past lettings including the number of bidders, bid amounts, low bid, and engineer's estimate.

  – Current lettings updated to the Web real-time on the letting day.

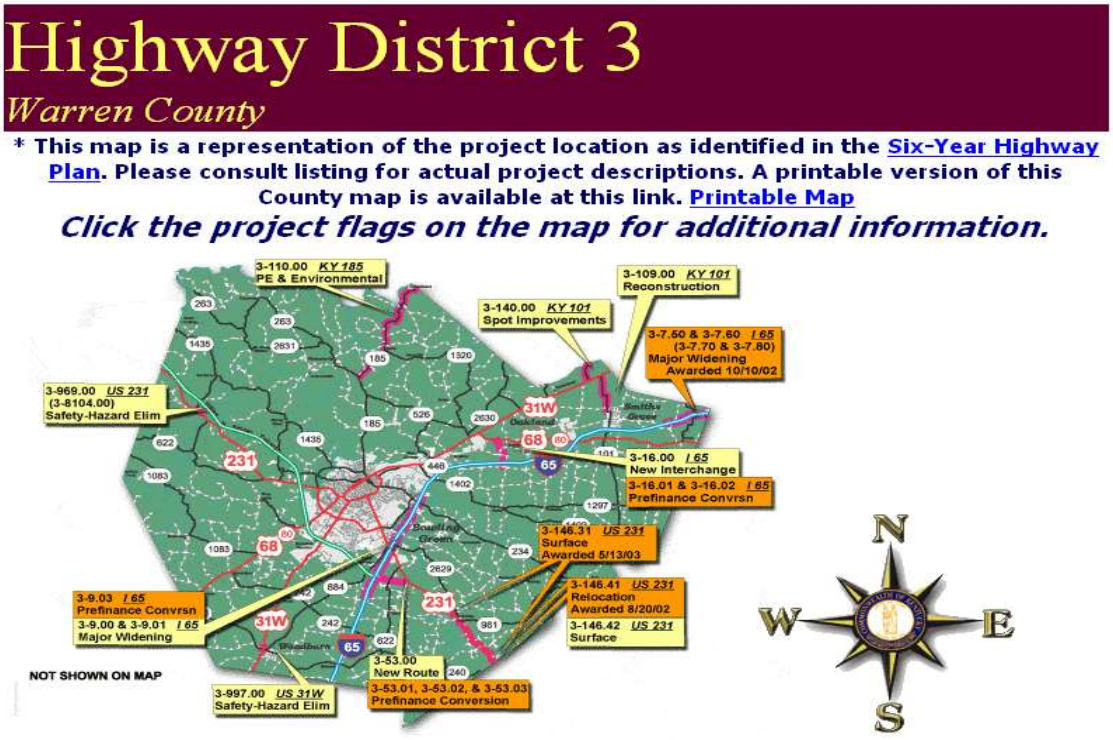
- **Information about approved projects is available on the Kentucky Transportation Cabinet web site.**

  Information about approved projects is also available to the public on the Cabinet web site. The format and amount of information varies depending on whether the project is in the preconstruction or construction phase, with considerably more information available for the preconstruction phase.

  Projects are mapped by county on the Cabinet web site. Each project is represented by a flag on the map. If a construction contract has been awarded, the award date is on the map. The user can then drill down for

more information indicated by selecting and clicking on the project. Depending on the project phase, the user will be presented with additional information which varies for each project. Exhibit IX-4 shows the map based interface on the Cabinet's web site which can be used to select a project of interest by county.

Exhibit IX-4: Map Based Project Information Tool on the Kentucky Transportation Cabinet Website



For projects where construction has not yet begun, users are given additional information drawn from the Six-Year Highway Plan application including location, project contact, frequently asked questions about the project, and some summary financial information on the current estimated cost of each project phase and amounts authorized by phase. While reasonably detailed, this information can be confusing due to the use of acronyms and abbreviations. Exhibit IX-5 shows the base information and the links to additional areas of detail information available on the Cabinet's web site for a project in the pre-construction phase.

Exhibit IX-5: Information Available on the Kentucky Transportation Cabinet Website for Projects during Preconstruction

Six-Year Plan Project Information

Highway District:	3
KYTC Item:	16
Project Description:	CONSTRUCT NEW INTERCHANGE ON I-65 TO ACCOMODATE MAJOR DEVELOPMENT POSSIBILITIES NORTH OF BOWLING GREEN.
Type of Work:	NEW INTERCHANGE(O)
Project Status:	Active
Contact Person:	KENNETH.COX@MAIL.STATE.KY.US
	K. W. COX
	900 MORGANTOWN ROAD
	P.O. BOX 599
	BOWLING GREEN
	42102
Phone:	(270) 746-7898
FAX:	(270) 746-7643

- Frequently Asked Questions
- Project Locations
- Current Phase Information
- 2002 Six Year Plan Phase Information

For projects under construction, the user is taken to a page that contains the actual or estimated construction start date, the amount of the contract, and the estimated percentage completed. In addition, contact information is given for the Chief District Engineer of the district where the project is being constructed. Exhibit IX-6 illustrates the information available for projects in the construction phases and shows the inconsistency between the information provided for projects in the preconstruction and construction phases. These inconsistencies include a different format for the base information, with no links or options to obtain additional, more detailed information.

Exhibit IX-6: Information Available on the Kentucky Transportation Cabinet Website for Projects During Construction

b. Project Information Provided to the General Assembly

- **The Kentucky Transportation Cabinet provides the General Assembly with a summary of Six-Year Highway Plan application and other project status in the LRC data set. This is not always received on time and is consequently becoming less useful to LRC staff.**

  Summary level financial and project status snapshot information on projects in the Six-Year Highway Plan application is provided to the LRC as part of the monthly LRC reporting database provided by the Cabinet to the General Assembly. This extract of project information is mandated by statute and is intended to allow LRC staff to perform a significant amount of research and analysis on its own. It is supposed to be provided to the LRC by the 15th of each month for the previous month.

In practice, however, the LRC does not always receive the LRC dataset in a timely fashion. As of the end of November 2003, for example, the LRC Transportation staff was still working with the June 2003 LRC Dataset. Thus, LRC staff is finding the LRC dataset less useful than intended and are now relying more on a printed monthly status briefing book prepared by the Cabinet.

In addition, the LRC dataset, since it is an extract from multiple Cabinet systems, seems to require considerable effort to produce.

- **In the past, some LRC staff had access to various management systems. With the exception of the Highway Inventory System, the Legislative Research Commission currently does not have access to any of the Cabinet's systems.**

  The LRC transportation staff has had, in the past, access to the Project Authorization System, the Six-Year Highway Plan application, and the Contractor Pay Estimate System.. Discussions with the Cabinet and LRC staff revealed it was not completely clear why the LRC no longer has access to these systems. The actual reasons are likely a combination of factors, including system changes to the Contractor Pay Estimate System in support of the MARS implementation and the changes in technical infrastructure at the LRC such as new desktops from which configurations needed to reach some systems may have been deleted.

E. Question 4: How do the Transportation Cabinet's project management and control systems and ease of reporting project status both internally and externally compare with those of other transportation agencies nationally?

There is an interest in understanding how the Cabinet's project management and control systems compare with those of other transportation agencies nationally and whether there are opportunities to learn from other agencies how to improve the overall quality of the Cabinet's project management and control systems.

1. Answer

For the most part, the Cabinet's current project management and control systems, and its plans for enhancements to these systems (such as the migration to the Trns*port suite), are very comparable with other transportation agencies. Based on our review of best practices and our experience working with other transportation agencies, however, three areas where the Cabinet can learn and adopt from other transportation agencies are:

- Adoption and use of a project scheduling tool.

- Availability of a management level project dashboard or snapshot functionality, as well a comprehensive set of management reports.
- Development of a utilities tracking function.

2. Analysis Strategy

Our analysis approach included the following steps:

- Evaluation of existing systems documentation.
- Review of product information or other available documentation about functionality of systems currently in development or planned for implementation.
- Interviews with business owners for key systems
- Review and comparison of Cabinet applications with best practice information derived from other Dye Management Group, Inc studies.
- Follow-up discussions with staff at other transportation agencies and/or vendors as appropriate.

3. Findings

a. AASHTO Trns*port

- **AASHTO's Trns*port module is the only commercially available package solution designed to automate the preconstruction functions.**

  The Cabinet is in the process of replacing a number of legacy custom applications which support the preconstruction and construction functions with the AASHTO Trns*port software suite. Adoption of this off-the-shelf software solution should allow the Cabinet to lower overall cost of ownership and reduce the complexity of its application portfolio.

  The Cabinet is scheduled to deploy several modules of the AASHTO Trns*port solution in early 2004 to replace a series of primarily mainframe custom systems supporting contract procurement and cost estimating.

  AASHTO Trns*port is the only commercially available solution which automates the preconstruction management functions. States which have not adopted Trns*port have typically built custom systems. Depending on the breadth and depth of the functionality included in these custom systems, the costs to build application systems with functionality similar to Trns*port, based on the recent experience of other state transportation agencies, would be in the range of $5 million to $10 million.

- **AASHTO Trns*port's SiteManager module is the only commercially available package solution to automate the construction management functionality.**

  The Kentucky Transportation Cabinet currently uses the Contractor Pay Estimate System and the Kentucky Construction Engineering Program application, two Clarion/DOS based applications, for its contract administration and construction management functions, including daily record keeping, payment of contractor estimates, and processing contractor change orders. The Cabinet is implementing the Trns*port SiteManager module of the AASHTO's Trns*port suite to support the construction management functions and replace these two custom applications. SiteManager is scheduled for January 2005.

  Trns*port SiteManager was developed by AASHTO through a joint development project funded by 18 state departments of transportation and the FHWA. Currently, Trns*port SiteManager is licensed by over 20 states. It has been implemented to some extent by 12 state departments of transportation, including two of the largest, those of Florida and Texas. Other states using Trns*port SiteManager include Colorado, Nebraska, and Missouri. Implementation of Trns*port SiteManager is in progress in Virginia.

  Several states that have chosen to implement custom systems with similar functionality to Trns*port SiteManager have made considerable investments in developing these custom applications. Kansas, North Carolina, and Ohio have all developed custom construction management applications since the mid-1990s, with costs ranging from $3 million to $15 million plus. For example, based on reports prepared for the North Carolina Information Resource Management Commission, Hi-CAMS, North Carolina Department of Transportation's construction management application, cost approximately $15 million to develop.

b. Project Scheduling

- **A number of state transportation agencies have or are adopting project scheduling functionality.**

  A number of transportation agencies are working to make increased use of project scheduling tools. Some examples include:

  – The Project Management Improvement Initiative (PMII) is being implemented by the North Carolina Department of Transportation using the SAP Project Scheduling module as its base. The PMII initiative is focused on the preconstruction phase (planning and design) and is tightly integrated with the SAP project accounting functionality.

- The Tennessee Department of Transportation has recently deployed on a statewide basis a project management and project scheduling system based on the Primavera project management software.

- New Jersey Department of Transportation has also implemented Primavera statewide as its enterprise program/project scheduling tool.

c. Project Dashboard and Management Reporting

- **The Virginia Department of Transportation has adopted a Project Dashboard function to provide a standard snapshot project reporting and exception monitoring capability.**

  The Virginia Department of Transportation (VDOT) has implemented a Project Dashboard to provide VDOT staff and the public with a "Red, Yellow, Green Light" snapshot of project status. This application was developed to provide VDOT constituencies, including the legislature and the public, with improved access to the status of projects. The application has received favorable publicity in national publications and has been generally well received by the intended constituencies.

  Two screen shots from the Project Dashboard application are included as Exhibit IX-7 and Exhibit IX-8 below. Exhibit IX-7 illustrates the red, yellow, and green light functionality which compares project status against predefined criteria. Exhibit IX-8 illustrates the drill down capability which allows a user to choose a criteria (for example all projects identified as "Yellow" for advertisement schedule) and then see a list of projects meeting this criteria. The user can then choose one or more projects from this list for more detailed review of project information.

Exhibit IX-7: Virginia Department of Transportation
Project Dashboard Stop Light Functionality

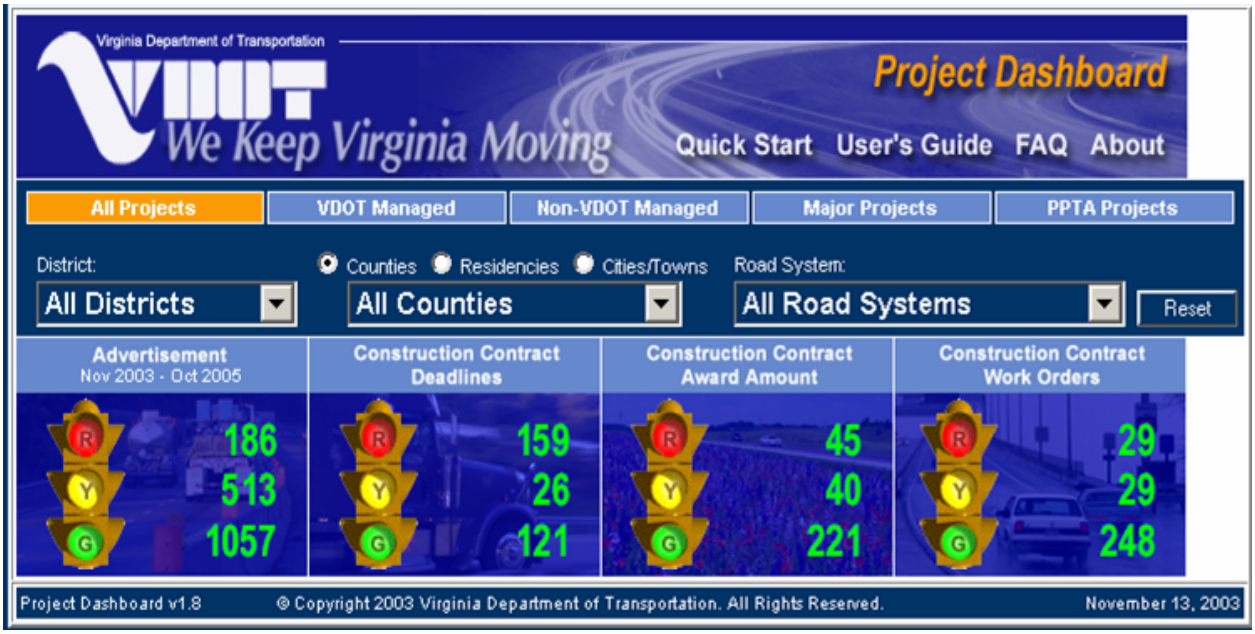
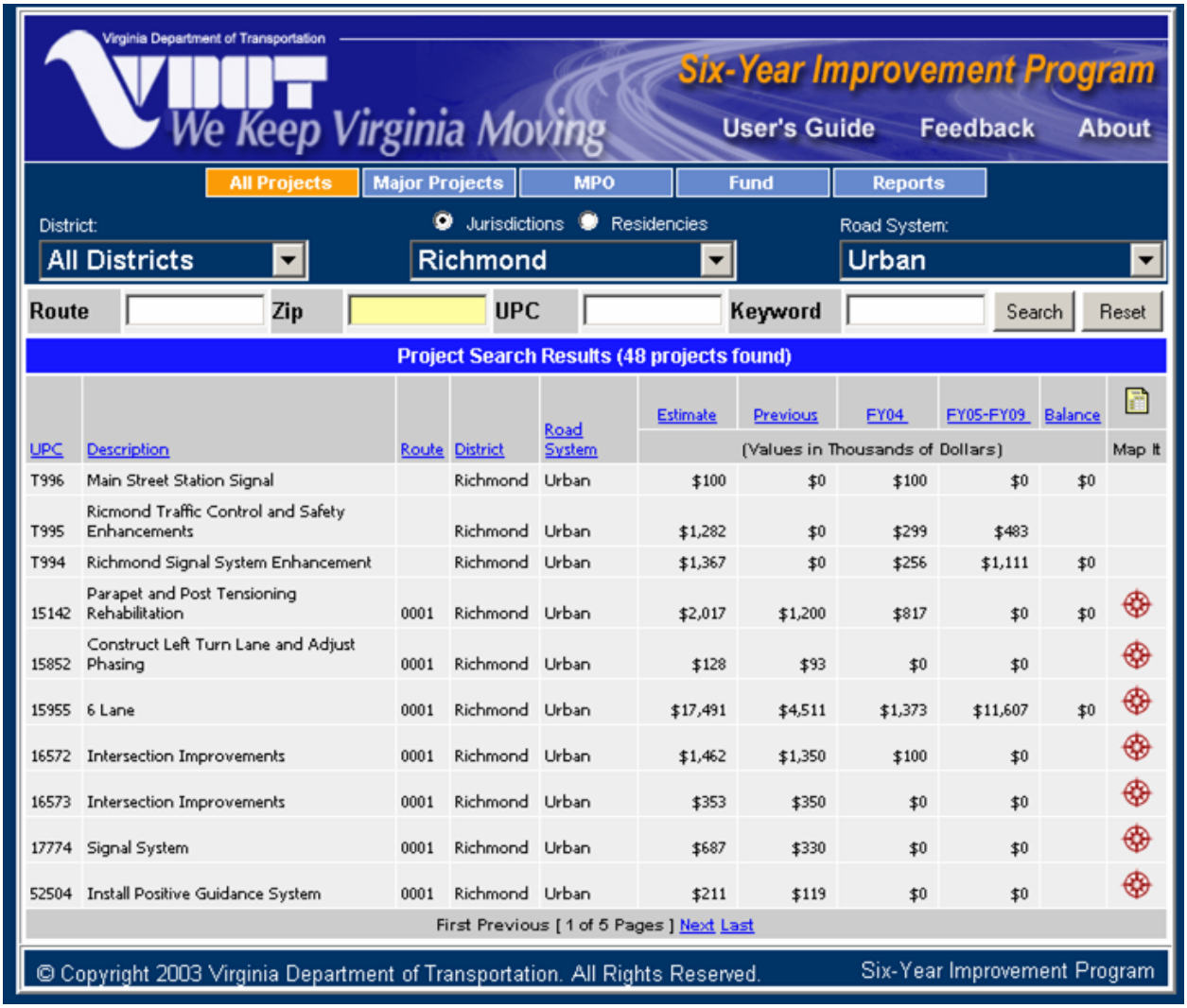


Exhibit IX-8: Virginia Department of Transportation
Project Dashboard Drill Down Capability



d. Utilities Tracking

- **The Virginia Department of Transportation has developed detailed utility tracking functionality as part of its Right of Way and Utility Management System.**

  The Cabinet had originally planned to implement both detailed right of way and utilities tracking functionality as part of its RWU application. To date, only the right of way functionality has been developed and implemented.

The VDOT did develop right of way and utilities functionality as part of its Right of Way and Utility Management (RUMS) system, which can track utility relocation at a detailed level.

F. Recommendations

1. Recommendation IX-1: Incorporate key milestone dates for the construction phase into the status reporting function of the Six-Year Highway Plan application.

The preconstruction status reporting function of the Six-Year Highway Plan application does include summary financial information for the construction phase. However, it does not provide any tracking of key milestone dates beyond the letting date. In order to establish more of an umbrella project management system over all phases and to create a single source for a snapshot of project status against key milestone dates, the Six-Year Highway Plan application should capture 3 to 5 key milestone dates for the construction phase. Examples of target milestone dates that could be tracked include construction conference, work initiated, work completed open-to-traffic, final estimate paid, etc.

Functionality to update these type of milestone dates is available within Trns*port SiteManager. However, Trns*port SiteManager does not provide the same audit trail capability currently available in the Six-Year Highway Plan application Thus, once implemented, Trns*port SiteManager could be the source for updates to these milestone dates, with an audit trail of changes maintained in the Six-Year Highway Plan application.

2. Recommendation IX-2: Develop a detailed project financial report for use by project managers to more closely control cost impacts to their projects.

Because of the renewed emphasis being placed on project managers having tighter control and doing a better job of estimating charges, this recommended report will be a valuable tool to help Cabinet project managers understand the nature of costs charged to their projects. This understanding will allow for quicker identification of problems and will result in improved estimates of project costs (both total cost to complete a project and monthly cash spend) going forward.

3. Recommendation IX-3: Implement a project scheduling tool to develop a basic critical path schedule for use during the preconstruction phase.

This recommendation calls for the adoption of a standard project scheduling tool for use on a Commonwealthwide basis throughout the preconstruction phase. The purpose of

the scheduling tool is to enable project managers to develop detailed project level schedules with appropriate resource loadings, critical path milestones, and interrelationships and dependencies between tasks.

This recommendation specifically emphasizes the development of a project level schedule and not a program level schedule which rolls up individual project schedules to show resource constraints (with project managers, designers, right of way staff, and other specialty groups) and associated schedule impacts across multiple projects. Extension of this scheduling effort to the program level can be a natural next step once the creation and use of a project level schedule has been institutionalized. However, it should be noted that development of program level schedules creates a substantial increase in the complexity of the project scheduling effort and the costs and benefits of undertaking program level scheduling should be carefully evaluated before attempting this step.

The project level schedule would be developed by the Cabinet project manager for in-house design efforts and could be developed for all externally designed projects, using a predefined format, either by the consultant project manager or as a joint effort between the consultant project manager and the Cabinet project manager. This project schedule would support the updates to the milestone dates maintained in the Six-Year Highway Plan application.

In terms of the actual deployment of the new project scheduling tool, the following steps are recommended:

- A task team of experienced Cabinet project managers should be formed to define requirements and evaluate tools available in the marketplace. Tools currently used by other transportation agencies include Microsoft Project, OpenPlan, and Primavera.
- Once the tool is selected, specific templates should be built for each of the major types of projects for Cabinet staff to use as a starting point for building their project work plans and schedules.
- Training should be Cabinet context specific (versus standard vendor training) and incorporate the templates.
- The selected tool should be piloted on several projects across different districts before being rolled out for use Commonwealthwide.
- The templates should be made available as the starting point for project schedules developed by consultants to ensure consistency across projects.

4. Recommendation IX-4: Implement a standard set of project management reports and easy to use ad hoc query capabilities to provide snapshot status information on projects across the entire project life cycle and the ability to more easily query project information to allow for managing by exception.

This recommendation involves implementing a set of standard project management reports to provide the Cabinet senior managers with the status of projects based on a number of critical success factors. Some examples of these critical success factors could include:

- Actual expenditures versus original and/or revised approved project budget.
- Performance against target milestone dates.
- Actual number of right of way acquisitions completed as a percentage of total or as a percentage of total supposed to be completed by a certain date.
- Total number of change orders.
- Change order amount as a percentage of total budget.

This functionality will then allow Cabinet program managers to filter projects on an exception basis against these critical success factors.

A Project Dashboard application that provides a great deal of this functionality has recently been implemented by the Virginia Department of Transportation. It uses a green light, red light, yellow light system to evaluate projects against certain predefined criteria and then allows the user to drill down to greater levels of information about projects classified within each color.[1] Screen shots from this application are included in Section IX.E.3.c.

In addition to the standard report set, Cabinet senior management and program managers (District Branch Managers, District Engineers, Division Directors, and Deputy State Highway Engineers) need the capability to more easily perform ad hoc queries of data throughout the project life cycle. Some representative examples of reporting selection criteria could include:

- Projects scheduled to be let in the next two lettings which still have outstanding issues on right of way or utilities.
- Projects which have missed, or are scheduled to miss, their original scheduled letting date by more than 60 days.

[1] This Project Dashboard is also available to the general public and may be viewed at http://dashboard.virginiadot.org.

- Projects where projected right of way costs exceed the original right of way budget by more than 10 percent.
- Projects with more than a certain number of change orders, or projects where change orders as a percentage of the contract exceed 5 percent.
- Projects where total projected expenditures exceed original authorized budget by more than 10 percent.
- Projects where projected vs. actual cash expenditures for the previous month varied by more than 10 percent.

5. Recommendation IX-5: Provide LRC staff access to the Cabinet's primary project management and control systems in lieu of the Cabinet providing the current LRC dataset.

This recommendation calls for providing LRC transportation staff, and other LRC staff as requested, real-time, read only access to the Cabinet's primary project management and control systems, just as the LRC Transportation staff has access to the Highway Inventory System today. The applications to which LRC staff should have read-only access would include the Project Authorization System, the Six-Year Highway Plan application, the Right of Way and Utilities System, and the Contractor Pay Estimate System. Access to the Trns*port modules including Trns*port SiteManager should also be provided as these modules are migrated to production. In addition, the LRC should be given access to the standard set of project management reports and the ad hoc query.

Once the LRC staff has received access to these key management systems, the General Assembly should consider revising the statue to substitute electronic access to key management systems instead of requiring the Cabinet to provide the monthly LRC dataset.

The benefits of this recommendation include:

- Improved access to project management information by the LRC staff who will have real-time access to information versus the LRC data set snapshot which is at a minimum 15 days old and often considerably older.
- Elimination of the effort on the part of the Cabinet required to produce the LRC dataset.

6. Recommendation IX-6: Continue implementation of the AASHTO Trns*port suite for letting, award, and construction management functionality.

The Cabinet is implementing components of the AASHTO Trns*port suite for cost estimating, letting and award, and construction management functionality. The Trns*port

letting and award functionality is scheduled to go live in early 2004 and Trns*port SiteManager to support construction management is targeted for January 2005.

As a joint development solution, the Trns*port suite represents the current state of the practice. The current Cabinet applications, while providing a great detail of functionality, are approaching the end of their useful life from a technology perspective and the Cabinet has only a handful of staff who know how to support these applications. Thus, the preconstruction management and construction management urgently need to be replaced. The only reasonable alternative to the Trns*port suite is to custom develop an application and the recent development of custom applications has been costly, time-consuming efforts for other transportation agencies. In addition, the Cabinet has already invested considerably in moving forward with these implementations and, given the age of the existing systems, time is of the essence in completing implementation.

7. Recommendation IX-7: Standardize information presented on the Cabinet web site about all projects regardless of project phase.

This recommendation involves the standardization to the extent possible of project information available, regardless of its phase in the life cycle. Consistent , easy to understand information for a non-transportation user should be provided for the project location, primary contact, scheduled dates by phase, current estimated budget, amounts authorized, and total amounts expended by phase. For projects in the construction phase, key contract and project schedule information should be provided including:

- Contract letting date, contract award date, contractor, and contract award amount.
- Number of change orders, date of most recent change order, net change order amount.
- Current contract amount and current amount earned.
- Estimated date of project completion.
- Percentage complete based on Cabinet project manager’s estimate.
- Special traffic notices or other construction schedule information of importance to the public.

In addition, the Cabinet should consider making available on the web site some portion of the standard project management reporting set. The Virginia Department of Transportation has received considerable positive publicity for how its Project Dashboard functionality has helped to improve access to information and overall communications with the general public.

The benefits of implementing this recommendation include:

- Consistent presentation of project status regardless of project phase.
- Enhanced public availability of information on Cabinet activities.

8. Recommendation IX-8: Create tighter linkage between the Six-Year Highway Plan application and Right of Way and Utilities application to provide project managers with enhanced capability to focus on and manage right of way and utility exceptions.

This recommendation involves providing the capabilities to go from summary level right of way information in the Six-Year Highway Plan application to more detailed data on the right of way and utilities application to allow project managers to quickly identify individual parcels which are, or have the potential to be, issues and then to work with the right of way staff to manage these parcels on an exception basis.

9. Recommendation IX-9: Complete the Utilities functionality planned for the Right of Way and Utilities application and link this detailed information with the Six-Year Highway Plan application for detailed exception reporting and analysis by project managers.

This recommendation involves completing the planned detailed tracking capability at the individual utility relocation level within the right of way and utilities application and linking this new detail level functionality with the Six-Year Highway Plan application to generate the Utility Summary information. This functionality would replace the data entry of the Utility Summary information in the Six-Year Highway Plan application. This recommendation also includes providing drilldown capability from the Six-Year Highway Plan application to the new utility functionality in the right of way and utilities application to allow project managers to quickly identify relocation issues and to work with Cabinet utilities staff and the utility itself to manage these parcels on an exception basis.

Utility relocations are typically a critical path item in the project schedule and can often have a tremendous impact on the ability to meet a desired project time frame. In addition, since Cabinet staff is dependent on the utilities, which likely have their own, conflicting priorities for completing the work, it is even more critical that the Cabinet carefully monitor required utility relocations at a detail level.

10. Recommendation IX-10: Consolidate the Gold File and Unscheduled Needs application to implement a single repository for all candidate projects.

This recommendation involves consolidating the Gold File and Unscheduled Needs applications to a single database of candidate projects, with projects flagged according to source and other key criteria to facilitate filtering of projects for reporting and analysis. In conjunction with this recommendation, the Cabinet should also consider developing a web-based project request or identification form to replace the existing paper form which is currently completed by the requestor and entered manually into

the Unscheduled Needs or Gold File. The web-based project identification form could be used by the Cabinet staff, General Assembly members and staff, and Area Development District staff and others authorized by the Cabinet to enter basic project information, which could then be routed to the appropriate Cabinet staff for review, comment, and estimating.

The consolidation of the Gold File and Unscheduled Needs application could occur within either the existing Gold File application or the existing Six-Year Highway Plan application since both of these are on the Oracle database platform or within a new consolidated Oracle-based application.

The benefits of implementing this recommendation include:

- Elimination of duplicate information about candidate projects.
- Streamlining of the Cabinet's application portfolio through consolidation of the Gold File and Unscheduled Needs Application.
- Migration of the unscheduled needs functionality from Dbase (maintained by a non-Information Technology staff member) to the Cabinet's enterprise platform.
- Streamlining of the project identification process through elimination of duplicate data entry.
- Reduction in the Cabinet staff effort and reduced potential for errors through capturing information closer to the source through a web-based project identification form.

X. Disadvantaged Business Enterprise Program (DBE) Compliance and Certification

■

This section provides a management-level review of the management controls and procedures that the Cabinet has instituted to address prior failings of the Disadvantaged Business Enterprise Program (DBE). Rather than duplicate prior audit analysis and investigative studies, the scope of this analysis is to assess whether or not the Cabinet has instituted procedures that reflect best practices in ensuring that only firms truly meeting DBE eligibility criteria are certified and that DBE firms truly perform the contracted work.

To address this narrowly defined scope, the questions evaluated are:

- **Question 1:** Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE met the certification requirements?
- **Question 2:** Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE do in fact perform work on construction projects in compliance with construction contract requirements?

The Cabinet has placed management attention on the DBE program, given the high profile of legal indictments regarding misrepresentation and false certification of DBE firms, and the General Assembly directed this study to address the narrow area of the policies and procedures instituted to prevent future occurrences of misrepresentation and false certification.[1]

A. Background

1. What is the Disadvantage Business Enterprise Program?

Federal law requires that recipients of federal road funds develop a program to promote the use of DBEs. There are specific regulations determining what constitutes a DBE.

2. What is DBE Certification and Compliance Review?

As a requirement for receiving federal funding, the Kentucky Transportation Cabinet is required to establish a DBE program administered under the rules and guidelines in

[1] Louisville Courier Journal, April 22, 1994 reported indictment by a federal grand jury on charges of running bogus minority-owned highway construction firm.

the Code of Federal Regulations (Title 49, Part 26.). The objectives of the DBE program are to:

- Ensure non-discrimination in the award and administration of federal-aid contracts.
- Create a level playing field on which DBEs can compete fairly for federal-aid contracts.
- Ensure that the Department's DBE program is narrowly tailored.
- Ensure that only firms that fully meet the eligibility standards are permitted to participate as DBEs.
- Help remove barriers to participation of DBEs in federal-aid contracts.
- Assist in the development of DBE firms so they can compete successfully in the marketplace outside the DBE program.

To ensure these objectives are recognized, the DBE program employs the two components of certification and compliance. In order for small disadvantaged firms, including those owned by minorities and women, to participate in the federal financially assisted contracts of state and local transportation agencies, they must apply for and receive certification as a DBE. To be certified as a DBE, a firm must be an independent small business that is owned and controlled by socially and economically disadvantaged individuals. The second component is compliance, which monitors federal-aid projects. The focus of the DBE compliance process is to ensure that the contract agreements between the prime contractor and DBE are adhered to and that discrimination is not occurring at the project site. The intent of the DBE compliance review is to ensure that the DBE is performing a commercially useful function as specified in the contract documents and to determine the amount of DBE expenditures that can be credited toward the prime contractor's DBE participation goal.

a. The Transportation Cabinet's recent history.

After an investigation of allegations in May 2002, the Federal Highway Administration found that Kentucky was not in compliance with the federal DBE regulations. Governor Paul E. Patton appointed Joseph Famularo, former US Attorney, to analyze the allegations and current practices that led to these findings. Mr. Famularo formed the Program Review and Reform Committee. This Committee conducted a detailed investigation of practices and prepared the Program Review and Reform Committee Report[2] that includes specific recommendations for the Cabinet to bring their DBE program and practices into compliance with federal regulations.

[2] Available: http://www.kytc.state.ky.us/News/RevisedPRRCReport.pdf.

The Program Review and Reform Committee concluded that the Cabinet needed to create an Office of Inspector General (OIG) to promote accountability and efficiency within the organization and to create a process to address issues in a timely and organized manner. The recommendation included establishing a formal mechanism for monitoring business processes and promoting accountability. In response to these findings representatives from the Office of the State Highway Engineer, Division of Contract Procurement, Division of Construction, Office of Technology, and the Office of Minority Affairs were organized to address the Program Review and Reform Committee findings and recommendations. As a result, the Office of Minority Affairs was reorganized with the appointment of a new Executive Director, a new DBE Liaison, and a new DBE Program Manager, all with many years relevant experience.

B. Question 1: Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE meet the certification requirements?

The Cabinet implemented organizational and procedural changes as part of corrective action in the wake of a high-profile scandal to get back into compliance with federal DBE requirements. To answer this question, we compared these corrective actions to best management practice.

1. Answer

The Cabinet generally implements best practices, but our analysis identifies some further changes that can strengthen the program and reduce risk. The Cabinet has implemented considerable improvements to its procedures for ensuring that firms certified as DBE meet the certification requirements. Although the procedures that have been implemented address the major risk areas, there is still room for improvement, most notably in the operation of the DBE certification review panel. Our analysis did not evaluate how effectively the new procedures are followed; however, interviews with Cabinet employees did not suggest this to be a risk area.

2. Analysis Strategy

Our analysis approach involved the following steps:

- Evaluation of recommendations and analysis from prior studies and investigations.
- Review of documented policies and procedures.
- Best practice survey of neighboring states.
- Interviews with certification and compliance managers.
- Selected interviews with district staff.

3. Findings

- **The Office of Minority Affairs has a clearly defined program and set of business rules for certifying DBE firms and reaffirming eligibility.**

  To strengthen the DBE program management and to provide management oversight, the following improvements have been made to the Cabinet's DBE Certification Program:

  - DBE applications received by the Office of Minority Affairs are assigned a number and evaluated for completeness. Incomplete applications are returned with a list of the required information. Completed applications are assigned to investigators for processing, with each investigator receiving an equal number of cases.
  - Investigators have 45 days to process the application and present a recommendation to the DBE Certification Committee. Case files are submitted to the DBE Certification Committee at least seven days before scheduled meetings. Investigators must be available to answer questions from the DBE Certification Committee. Detailed explanation is required when an application is rejected. The impacted firm has state and federal administrative measures it can use to challenge the panel's decision.
  - Record keeping and file maintenance is done uniformly and secured to protect confidentially. An inventory of files is updated monthly.
  - The DBE Directory, a listing of all certified firms, is updated within three days of each monthly Certification Committee meeting. The directory is on the Office of Minority Affairs website.
  - DBE staff receives recurring training from the Federal Highway Administration officials on DBE regulations.
  - Desk audits of certification files are done to reaffirm the program eligibility for each DBE certified firm.

- **Transportation Cabinet procedures reflect best practice.**

  The best way to comply with federal law is to consistently certify DBE firms and organize a follow-up and review of compliance practices. Federal law requires the Cabinet to ensure the equal treatment of every DBE applicant and be fair and honest in awarding contracts to meet DBE goals.

  The following best management practices are in place and we understand that they are being followed:

  - Cabinet DBE certification staff uses 49 CFR Part 26 as its guide to recommending certification. This practice is consistent with neighboring

states that were interviewed as well as consistent with the federal requirements for the DBE program.

- Certification staff are well trained in the federal DBE regulations and state specific policies and procedures.
- A finance person knowledgeable about financial statements and tax filings of both businesses and individuals is reviewing the potential DBEs financial statements and the personal net worth statements for each partner.
- The Cabinet is reviewing the potential DBEs employment records demonstrating that the demographics of its employee base complies with the state's requirements based on the project location and type of work.
- The Cabinet is conducting an annual review of firm financial statements and DBE partners' personal net worth and tax return statements.
- A recertification procedure is in place that is timely and consistent and ensures that the state remains in compliance with the federal regulations.
- Investigators do in-depth reviews when a firm displays practices that are non-compliant with federal or state regulations.

- **The Transportation Cabinet has an appropriate level of staffing with four certification investigators and two certification advisors.**

  The size of Cabinet staff is consistent with other states' DBE programs of similar size. The Cabinet currently has approximately 400 DBE certified firms and a backlog of approximately 90 firms that are awaiting either a certification or recertification decision. These firms engage in both highway and non-highway activities.

C. Question 2: Has the Transportation Cabinet implemented effective procedures for ensuring that firms certified as DBE do in fact perform work on construction projects in compliance with construction contract requirements?

The purpose of this question is to provide an independent perspective on the Cabinet's procedures to ensure that DBE firms perform work in accordance with the requirements in the state's prime contract relative to subcontract work.

1. Answer

Yes, the Cabinet's policies and procedures are in alignment with best practice for compliance monitoring; however, there are no standardized guidelines for applying sanctions for noncompliance. Responsibility for monitoring compliance lies with the Cabinet's construction engineering staff in the Districts and with the contractor. They

are required to ensure that there are no discriminatory acts on the job site as required by Title VI of the Civil Rights Act and that the DBE performs a commercially useful function. A commercially useful function means the DBE firm is responsible for the execution of work in the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved. In addition, the DBE must be responsible for procuring materials, negotiating quantities and prices, and ordering, paying for, and installing the material.[3] Conducting periodic compliance audits through third parties such as the state auditor and enforcing existing sanctions for noncompliance are both mechanisms for further reducing risk in this area.

2. Analysis Strategy

Our analysis approach involved the following steps:

- Evaluation of recommendations and analysis from prior studies.
- Review of documented policies and procedures.
- Best practice survey of neighboring states.
- Interviews with compliance managers.
- Selected interviews with District staff.

3. Findings

- **The Transportation Cabinet has strengthened overall compliance management practices to address past deficiencies in accordance with best management practices.**

  The Cabinet has addressed best practices as follows:

  – A "Good Faith Committee" has been established and formal operating procedures have been implemented as recommended by the Program Review and Reform Committee. (Appendix E to PRRC report.) A Good Faith Committee makes determinations regarding the good faith effort extended by the prime contractor to fulfill the DBE requirement on a contract. According to the Cabinet's special notes regarding contracting, "Where the apparent lowest responsive bidder fails to submit sufficient participation by DBE firms to meet the contract goal and upon a determination by the Good Faith Committee based upon the information submitted that the apparent lowest responsive bidder failed to make sufficient reasonable efforts to meet the contract goal, the bidder will be offered the opportunity to meet in person for administrative reconsideration."

[3] 49 CFR 26.55 Subpart C. Available: http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi?

- Project level DBE goals are based on geographic location of the project, the project content, and the availability of qualified DBE providers for specific project tasks.
- The contract bidding and award process is based on specified federal DBE regulations. They require that a contract be awarded only after the submission of a plan to meet the DBE goal. A DBE must be certified and prequalified prior to the bid opening and the amount of DBE participation has to be certified by the contractor in the bid documents. A DBE Participation Plan must be submitted to the Cabinet by the contractor prior to the award of a contract. The low bidder must demonstrate that he or she has exercised a good faith attempt to meet the DBE goal.
- Payments to DBE firms are tracked to ensure that the prime contractor is paying them in a timely manner and in the amount stated in the contract.
- Compliance monitoring is performed by project level staff in each of the Cabinet's 12 districts under the supervision of the resident engineer who manages the project. Compliance monitors complete a monitoring report form in the field. Office of Minority Affairs staff report any suspicious or unusual circumstances for further investigation. DBE's decertification proceedings and/or suspension for non-performing are recommended to the DBE Certification Committee.
- Project level staff receives training at each district office by the Division of Construction and the DBE Branch of the Office of Minority Affairs on compliance monitoring requirements.

- **The Transportation Cabinet is applying compliance review best practices.**

  The Cabinet has policies and procedures for applying the following practices that will ensure the prime contractor and DBE firms (one of which may be the prime contractor) meet the compliance regulations and make a good faith effort to meet the DBE goals for each project:

  - Adequate compliance staff well trained in the federal DBE regulations and state specific policies and procedures.
  - Staff knowledgeable about their region/division of responsibility and the DBE contractors and non-DBE prime contractors that may use DBE contractors for specific work.
  - Adequate coverage of knowledgeable staff that does site-visits on a regular basis. Making site visits is the key to efficient and effective compliance best practices.
  - Consistent review of the DBE goals for each contract and tracking the actual contract payments to DBE firms.

- Review of DBE firm's payroll history and employee demographic information. Plus, the review of the DBE firm's policies for Equal Employment Opportunity (EEO) and affirmative action employment practices.
- Annual requests for compliance information from each DBE firm that has active contracts with the state.
- Investigators that do in-depth research into a DBE's primary management, financial, and employment practices.

- **The Kentucky Transportation Cabinet DBE staff is not involved with routine contract compliance reviews. This function is the responsibility of the District EEO Officer, Resident Engineer, and Office of Contract Procurement.**

  The contract compliance review is mostly performed during a defined wage and hour week. If during the contract compliance review, major issues are found that indicate the DBE firm is not performing the work it was contracted to perform to address the DBE goal on the project, or is not making appropriate contract or financial arrangements, or is not performing a commercially useful function, the DBE certification staff will be requested to conduct a certification review. The Cabinet can impose penalties on the prime contractor for major DBE non-compliance such as denying DBE credit for the work in the contract; suspending active pre-qualification of the prime contractor and/or DBE firm for a period of time; or decertifying the DBE firm. The Cabinet has imposed these penalties on occasion and decertified DBE's.

  The Cabinet's practices are common to most states with the DBE certification and DBE compliance functions performed as separate and distinct activities. The certification process focuses on ownership and control while the compliance process focuses on commercially useful functions. Infrequently are the two processes in tandem. The only time the DBE compliance staff and DBE certification staff work together is when there is a major non-compliance finding.

  Cross-training should occur between the DBE compliance staff and the DBE certification staff. Also, when a compliance review is scheduled, the DBE compliance officer should advise the central office DBE certification staff in writing. The compliance notice should be included in the DBE's certification file. This information might prove valuable during recertification reviews. These three endeavors will facilitate understanding and communication between the two specialties. Also, a database should be developed and shared between the DBE certification and DBE compliance staff regarding issues to be aware of and general program statistics.

- **The Transportation Cabinet conducts DBE compliance reviews on every project that has DBE participation.**

  Larger projects have DBE compliance reviews performed twice a year on defined wage and hour weeks. Also, random compliance checks are done. The Resident Engineer, inspectors, and EEO officer participate in the reviews. The practice of conducting DBE compliance reviews is common to most states. The decision to conduct a review and the depth of the review is the responsibility of the states. Some states conduct a compliance review on each project that has DBE participation, while other states review a random cross-section.

  The Cabinet should continue conducting a compliance review on each project that has DBE participation. The district compliance officers should advise the central office certification staff of positive as well as negative findings. There should be a statewide policy on state penalties that are imposed beyond the federal standard of withholding credit for noncompliant work. The State could be more active in applying sanctions such as the suspension of prequalification, reduction in prequalification capacity, and statewide debarment. Since the DBE certification is used by non-highway related ventures, other state agencies should be advised to suspend participation with the noncompliant DBE for the period specified by the Cabinet.

- **Currently there are no statewide standards for the application of sanctions against prime contractors or DBE subcontractors.**

  There are no guidelines or standards for the consistent application of sanctions for noncompliance. If the same infraction occurred in more than one district, different enforcement measures may be employed in each district. This subjective, case-by-case enforcement practice causes confusion and a lack of confidence in the contracting community as well as in Cabinet staff.

D. Recommendations

1. Recommendation X-1: Reconfigure the DBE certification panel to include the DBE staff and increase the frequency of meetings.

The intent of this recommendation is to reconfigure the DBE certification panel to include the DBE staff and any agency designee. Individuals external to the DBE program should be allowed to attend the meeting to provide input, but not to render a decision. This process will help remove the perception that non-merit employees can guide the DBE certification process. Also, the proposed reconfigured DBE certification panel should meet weekly to render certification decisions. The frequency of the meeting will help facilitate the reduction of the current backlog and future backlogs. Regardless of membership composition, all DBE certification panel members should be required to participate in training sessions with certification staff

regarding the DBE standards, on-site visits, and document review so that they understand the process and rules by which certification recommendations are made.

Currently, the Cabinet's DBE certification staff sends recommendations for certification, recertification, and denial of certification, to the DBE certification review panel comprised of individuals external to the DBE program, per state administrative regulation code 600 KAR 4:010/020. The Director of Minority Affairs chairs the panel, but does not vote. The panel convenes on the fourth Thursday of each month to render DBE decisions, at which time it can override a DBE staff recommendation. In most states, the power to make the final DBE decision lies with the DBE staff and not with a panel that is external to the DBE program. Those states that have certification panels usually have certification staff as voting members. The reason is that a DBE administrative organization will want to have "individuals of knowledge" who will be answering DBE inquiries from the Federal Highway Administration and/or the United States Department of Transportation. While the certification panel receives periodic training on DBE requirements, it can introduce other considerations into the DBE certification decision process instead of strictly adhering to the code of federal regulations. Also the Cabinet's practice of rendering certification decisions on the fourth Thursday of each month contributes to the backlog. For instance, a firm that was recommended by the DBE staff on the first week of the month has to wait for a decision until the fourth Thursday.

2. Recommendation X-2: Assign Certification Investigators to specific geographic areas while balancing workload.

The current approach to addressing the certification backlog is for the Cabinet certification investigator to work on the next available file in the backlog. States address their backlog in different manners. Some states assign their investigators to work on DBE cases from specific geographic regions of the state. Other states assign cases by alphabet, regardless of geographic region. Out-of-state cases are assigned either by alphabet or by latest case in the backlog. The most desirable approach is to assign certification investigators to specific geographic regions of the state, which the Cabinet should implement. It will enable the investigator to acquire in-depth knowledge of DBE issues in his assigned area and provide travel and other organizational efficiencies. This approach will also provide the DBE firms with a contact person who is familiar with their areas. In assigning regions, care should be taken to divide the state based on the numbers of DBE firms. It is recommended that out-of-state cases be distributed by alphabet to the DBE certification investigators, regardless of geographic region. Teams of two investigators should continue to attend in-state on-site reviews for safety and validation reasons.

3. Recommendation X-3: Establish statewide standards for the application of sanctions against contractors or DBE subcontractors not in compliance with DBE requirements.

While administrative policies and procedures are in place with regard to contract compliance and monitoring, this recommendation addresses the need for standardized guidelines for sanctions to support enforcement.

It is recommended that standards be developed for the statewide application of enforcement measures. From a departmental perspective, Section 7(1) in the Cabinet's Rules and Regulations for Prequalification of Contractors should be actively applied. This provision states that: "Upon receipt of information or evidence that a holder of a certificate of eligibility has failed to perform satisfactorily or adhere to the laws, administrative regulations, or specifications applicable to a contract or subcontract, the department may take action to suspend or revoke the certificate of eligibility or to reduce the maximum eligibility amount."

Furthermore, the Cabinet should concurrently provide supporting information and request that the United States Department of Transportation apply the provisions specified in 49 CFR Section 26.107 (Subpart F – Compliance and Enforcement)[4], which state:

a. If you are a firm that does not meet the eligibility criteria of subpart D of this part and that attempts to participate in a DOT-assisted program as a DBE on the basis of false, fraudulent, or deceitful statements or representations or under circumstances indicating a serious lack of business integrity or honesty, the Department may initiate suspension or debarment proceedings against you under 49 CFR part 29.

b. If you are a firm that, in order to meet DBE contract goals or other DBE program requirements, uses or attempts to use, on the basis of false, fraudulent or deceitful statements or representations or under circumstances indicating a serious lack of business integrity or honesty, another firm that does not meet the eligibility criteria of subpart D of this part, the Department may initiate suspension or debarment proceedings against you under 49 CFR part 29.

c. In a suspension or debarment proceeding brought under paragraph (a) or (b) of this section, the concerned operating administration may consider the fact that a purported DBE has been certified by a recipient. Such certification does not preclude the Department from determining that the purported DBE, or another firm that has used or attempted to use it to meet DBE goals, should be suspended or debarred.

[4] 49 CFR 26.107 Subpart F. Available: http://frwebgate.access.gpo.gov/cgi-bin/get-cfr.cgi?

d. The Department (USDOT) may take enforcement action under 49 CFR Part 31, Program Fraud and Civil Remedies, against any participant in the DBE program whose conduct is subject to such action under 49 CFR part 31.

e. The Department (USDOT) may refer to the Department of Justice, for prosecution under 18 U.S.C. 1001 or other applicable provisions of law, any person who makes a false or fraudulent statement in connection with participation of a DBE in any DOT-assisted program or otherwise violates applicable Federal statutes.

XI. Right of Way and Utilities

This section addresses major issues in the acquisition of right of way and utilities relocation for Cabinet projects. Right of way acquisition and utility clearance are often cited as sources of delay and added costs in project delivery. This section describes existing right of way and utilities relocation business practices at the Cabinet.

The questions evaluated are:

- **Question 1:** How can the right of way process be undertaken more quickly and right of way costs reduced?
- **Question 2:** How can the utility relocation process be undertaken more quickly and at less cost?

A. Background

1. Right of Way Acquisition

Transportation agencies must acquire the land or real property rights (such as easements) needed for transportation facilities and improvements. This acquisition of right of way involves appraisals, negotiations, and contracts. The Cabinet right of way staff also attend to site preparation tasks including the removal of structures, the acquisition of any nearby water or monitoring wells, and the disposition of any underground storage tanks for hazardous materials. Right of way is also responsible for the management and disposal of any surplus right of way owned by the Cabinet.

Right of way clearance is a complex, expensive, and time-consuming aspect of project delivery. A single project may involve transactions for hundreds of separate parcels, each of which requires negotiations with the owners, whose rights at every step of the process are protected by state and federal law. Because policy and state law require right of way for transportation projects to be cleared before beginning construction (although this does not always happen in practice), it is on the critical path for delivering projects on time. Failure to clear right of way in a timely manner often results in schedule and cost overruns.

The single most important law governing acquisition of right of way by a public agency is the federal Uniform Relocation Assistance and Real Properties Acquisition Policies Act of 1970, commonly referred to as the Uniform Act. The Uniform Act details virtually every aspect of agency and landowner relations, including policies and requirements for appraisals and relocations and for payment of moving costs and

replacement housing. All federal, state, and local public agencies must comply with its provisions and its 1987 amendments. The Uniform Act sets specific standards for government's power of eminent domain and ensures compliance with the U.S. Constitution's 5th and 14th Amendments, which guarantee that private property shall not be taken for public use without just compensation.

Further complicating the Cabinet's right of way efforts is the fact that one in five acquisitions is contested by the property owner and has to be resolved through the state's right of eminent domain. Cases involving unwilling property owners are unpredictable in terms of their schedule and budget impacts. Only when the myriad of issues associated with all necessary property acquisitions (including condemnations) have been resolved can right of way be declared as cleared and the project ready for construction. Lead time for right of way clearance varies, but usually ranges between 8 and 24 months. Among the factors that affect the lead time for right of way clearance are the following:

- Number of parcels and types of acquisitions.
- Number of parcels requiring relocation assistance (residential and/or commercial).
- Number of improvements to be removed (e.g., buildings).
- Presence of hazardous materials.
- Time needed for condemnation proceedings.

2. Utilities Clearance

Transportation improvements, whether the building of new facilities or the rehabilitation or expansion of existing facilities, frequently need to shift the location of underground and above ground utilities, which include conveyances for electricity, natural gas, phone lines, water, and sanitary sewer. Utilities such as water authorities and sanitary sewer systems are typically publicly owned, while telecommunications companies, such as BellSouth, are generally privately owned.

Utilities are often located in the right of way and need to be moved prior to or during the proposed construction. Construction provides convenient opportunities to place new utilities or upgrade existing ones, as well as opportunities to mitigate unsafe conditions. In cases where the utilities are no longer used, they may simply need to be removed to allow construction to proceed.

While federal regulations govern virtually all aspects of right of way transactions (hence the term "Uniform" Act), regulations governing the construction, access to, and relocation of utilities vary tremendously on a state to state basis in terms of which entity is responsible for costs, what schedule requirements are needed, and what specifications are needed for the utility related work.

Laws regarding utilities relocation are contained in the following sections of the Kentucky Revised Statutes: KRS 177.035 and KRS 179.265. In Kentucky, utilities are divided into two classes, each of which is treated differently:

- Class I Utilities, which include telecommunications carriers, are privately owned. In almost all cases, they are responsible for the relocation costs, both engineering and construction, of their utilities found in the right of way. However, if a project acquires right of way for expansion, then the costs that the utility incurs in relocating are borne as part of the project costs.
- Class II Utilities, which are publicly owned entities including water districts and authorities, sewer districts, and school districts, are generally responsible for securing a consulting engineer to do the relocation engineering and then a contractor for the construction, but the Cabinet reimburses the costs.

KRS 177.035 and KRS 179.265 are very limited in their specificity. The statutes are specific with regard to the administration regulations governing reimbursement of costs. Their principal focus is to note that publicly owned utilities are eligible for reimbursement of costs. They say nothing about the timing or other specifications for privately owned utilities' obligations. Nor is there any reference to incentives or disincentives to complete needed relocations in a timely manner.

B. Right of Way and Utilities Organization

The Cabinet has right of way and utilities functions at both Central Office and district levels. The Central Office has statewide responsibility for the development of policies and procedures to ensure property acquisitions are completed in a timely manner and in accordance with applicable laws and regulations. In addition, Central Office personnel provide technical guidance to district staff, review and approve transactions, and maintain various statewide records.

At the Cabinet's Central Office level, right of way and utilities are organized together and headed by a Director of Right of Way and Utilities. The Director is assisted by two Transportation Engineering Branch Managers, one each for Right of Way and Utilities. The right of way and utilities function resides under Project Development, which reflects that the resolution of right of way and utilities issues is ideally accomplished prior to construction (although unanticipated problems in these areas often delay construction).

At the district level, separate supervisors for right of way and utilities, respectively, report to a Branch Manager for preconstruction. In 1998, the Cabinet revised its right of way and utilities practices to reflect the direction of the Empower Kentucky initiative. Under this division of labor, the Central Office maintains a significant role in authorizing expenditures, appraisals, transactions with landowners, and agreements with utilities. Meanwhile, district staff work with landowners (in the case of right of way) and utilities owners (in the case of utilities) to hammer out agreements, which must be reviewed and approved by the Central Office staff. According to Central Office management, there are two primary advantages of this division of labor:

- Management and staff in the state's districts have day-to-day contact with stakeholders and are familiar with their interests, properties, facilities, and needs.
- By retaining authority over the execution of any agreements, the Central Office can ensure that the Cabinet's policies and procedures are carried out in a fair and consistent manner. This is important in terms of adherence to the Uniform Act in the case of right of way, and it is important in dealing with utilities, many of whose facilities cross districts.
- The Central Office expressed that oversight is particularly important given the variation in the quality of right of way and utilities management among the districts, and given the districts' difficulty in recruiting, developing, and retaining qualified staff.
- Despite the general advantages that Central Office oversight provides, managers in the districts feel that the Cabinet's overall business processes for right of way and utilities need to be considered in depth—taking into account areas in which districts could exercise more authority in order to streamline the process without losing overall consistency and coordination.

C. Question 1: How can the right of way process be undertaken more quickly and right of way costs be reduced?

Right of way acquisition is one of the final steps in the preconstruction process, often cited as a bottleneck or source of delay in project delivery.

1. Answer

In recent years, the right of way function has had strong leadership and been well managed; however, opportunities exist to reduce the costs and the time it takes to acquire property. Analysis indicates that the majority of the time that letting has to be rescheduled it is due to right of way not being cleared. In many cases, this is likely due to the schedule for right of way work having become compressed. To reduce acquisition time, right of way staff should be involved consistently in the early stages of project development. The Cabinet's organizational capacity and professional right of way expertise should be further developed by improving the quality, scope, and availability of training for right of way staffs. In addition, better tools and data to track the right of way clearance process should be provided and then integrated with other aspects of the preconstruction project management system.

2. Analysis Strategy

The analysis approach involved:

- Analyzing all projects let within the past two years to assess schedule and cost adherence with regard to the right of way element of project delivery.

- Evaluating documented policies and procedures, including the Cabinet's *Right of Way Manual* and a variety of the Cabinet's right of way reports and statistics.
- Interviewing the Division Director for Right of Way and Utilities and the staff and management from four districts including Chief District Engineers, Preconstruction Branch Managers, and Right of Way Supervisors.

3. Findings

- **Right of way is the major cause of letting being rescheduled.**

  The measure used to determine performance of the right of way and utility phases was the percentage of projects let during the last two fiscal years for which a letting date had to be slipped due to right of way not being cleared. The number of months of the letting schedule slippage was also computed.

  The Kentucky Transportation Cabinet management tracks changes to the letting list schedule. This file contains a brief explanation of the cause that led to the rescheduling of the project.

  It was found that 123 projects' letting dates were rescheduled during the last two fiscal years due to right of way, utilities, design, or environmental issues. During this period, 1,073 projects were let, 317 of which are in the Six-Year Highway Plan. The letting list included 119 Six-Year Highway Plan projects that were rescheduled. This means that 38 percent of the Six-Year Highway Plan projects had to be rescheduled.

Exhibit XI-1: The Number of Project Letting Reschedules by cause of Delivery

Type of Delay	Number of Let revisions	Number of Projects	Percentage	Average Delay (months)
Design	47	40	15.3	3.1
Right of Way	176	70	57.3	3.5
Right of Way and Utilities	11	11	3.6	2.7
Utilities	39	30	12.7	4.5
Environmental	34	21	11.1	2.9
Total	**307**	**172**	**100.0%**	**3.5**

Source: Kentucky Transportation Cabinet Letting List Remarks.

These results show that by initiating the right of way acquisition process earlier a significant improvement in schedule can be achieved.

- **The Kentucky Transportation Cabinet's right of way tracking system (the Right of Way Status Report) is not effective.**

  Although data regarding each parcel's title status, appraisal value, relocation date, and purchase details are maintained electronically, this system is essentially a series of electronic lists. As such, data are stored on a project by project basis and cannot be sorted. Critical data are often missing or difficult to find. Therefore, project managers cannot access the data they need about the status of real estate transactions that are on the critical path. This is because the right of way status report is wholly separate from the Six-Year Highway Plan Status Report. In order to get data on the status of real estate progress, project managers have to go directly to the right of way staff assigned to the project. This is one area in which communication and coordination break down, and where delays occur.

- **The Kentucky Transportation Cabinet has challenges hiring and retaining qualified right of way staff.**

  In common with other transportation agencies, the Cabinet is struggling to attract, train, and retain qualified in-house staff and consultants. Staff and management shortages are due to retirements and general attrition. As noted in a synthesis of best practices in right of way published by the National Cooperative Highway Research Council, "Replenishment of right of way skills is a constant need." In fact, District 11 had lost its entire right of way section at the time of the consultant team interview due to retirements and a temporary reposting. Ready-made training specific to transportation agencies and the very detailed Uniform Act is not currently available, and right of way skills and knowledge are rarely part of any college coursework. The result of turnover combined with a dearth of training resources means that, at any time, a large percentage of right of way staff will be inexperienced and slower to work through right of way clearance.

- **Overall right of way is generally acquired within the authorized expenditure.**

  Across all the projects analyzed, right of way cost just 2 percent less than was budgeted as shown in Exhibit XI-2. However, there was substantial variations across the districts. For example, in District 1, right of way cost 61 percent less than the Cabinetwide average and, in District 7, right of way cost 117 percent more. This demonstrates the opportunity for strengthening budget management. The large increase was driven by a single project that incurred an approximate $2.5 million increase in right of way costs.[1]

[1] Project identification number 20724 on KY 90 bridge replacement in District 8.

Exhibit XI-2: Right of Way Expenditure Compared to Authorization by District

	Right-of-Way		
District	**Authorized ($)**	**Actual ($)**	**Variance (%)**
1	4,336,664	1,691,626	-61
2	1,660,000	704,278	-58
3	3,063,430	4,554,561	49
4	14,603,900	11,804,127	-19
5	11,862,338	13,355,631	13
6	10,562,253	20,344,347	93
7	24,464,176	18,100,798	-26
8	3,516,725	7,619,759	117
9	13,997,895	8,799,533	-37
10	5,686,820	2,788,223	-51
11	6,982,225	6,109,182	-13
12	17,974,687	20,755,324	15
Total	**$118,711,114**	**$116,627,390**	**-2**

Source: MARS, Six-Year Highway Plan.

Exhibit XI-3: Actual Right of Way Expenditures Compared to Authorized by Work Type

	Right-of-Way		
Type of Work	**Authorized ($)**	**Actual ($)**	**Variance (%)**
Highway Modernization	95,337,708	92,860,989	-3
Bridge Modernization	23,187,190	23,681,757	2
Pavement Preservation	30,365	24,944	-18
Bridge Preservation	100,000	13,671	-86
Other	55,850	46,028	-18
Total	**$118,711,114**	**$116,627,390**	**-2**

Source: MARS, Six-Year Highway Plan.

- **Inconsistency in the quality of right of way management among the districts was cited several times, at both Central Office and district levels.**

  Because efficient project delivery requires ongoing coordination with staff from multiple disciplines, it is important that right of way managers be skilled not only in the core competencies of appraisal, acquisition, and relocation, but that they also have project management skills and knowledge. To the extent that the

Cabinet develops its software tools, right of way staff will need training to become heavier suppliers, consumers, and analyzers of data.

- **The Kentucky Transportation Cabinet management and staff are ambivalent about the value added by consultants for right of way and utilities work.**

  Consultants providing right of way clearance service were frequently characterized as lacking in the technical knowledge needed to do the job; consequently, time has been lost as in-house staff have had to go back to complete the work originally contracted out. Although they are not happy with consultant performance, and although they face chronic personnel shortages, the Cabinet right of way managers have not established a strategy to get better results from their consultants.

D. Question 2: How can the utilities process be undertaken more quickly and right of way costs reduced?

1. Answer

Utility relocations can be undertaken more quickly and at less cost to the Cabinet by:

- Mitigating the risk and attendant cost and schedule overruns attributable to inaccurate, poor quality, and incomplete data on subsurface utilities through deployment of state of the art Subsurface Utility Engineering.
- Understanding and addressing private utilities' constraints on timely utility relocations.
- Having right of way and utilities Division Director conduct a detailed study to determine the optimal division of labor between Central Office and district staff in terms of approving utility agreements.
- Developing better tools and data to track the utilities relocation process and to integrate these tools and data with other aspects of the preconstruction project management system.

2. Analysis Strategy

The analysis approach involved:

- Evaluation of documented procedures including the Cabinet's Utilities and Rail Manual, Utilities and Rail Design Memoranda, and Empower Kentucky materials pertaining to utilities relocation.
- Interviews with Central Office management of the Right of Way and Utilities Division, and with Chief District Engineers, Preconstruction Branch Chiefs, Construction Branch Chiefs, and Utilities staff from four districts.

3. Findings

- **Better information on the location of utilities could reduce project costs and delays.**

  Poor quality data on the location and condition of utilities constitutes a major project risk, and one that we were told frequently leads to cost overruns and schedule delays. However, it was not possible to validate this through quantitative analysis.

  Data regarding the location of utilities is more often than not incomplete and inaccurate. Neither the utility companies, nor the Cabinet, typically know where utilities run relative to existing or planned highways. Design proceeds nonetheless, and the project is often in construction when utilities must be designed around or relocated. This problem is not peculiar to Kentucky. It is an issue nationwide.

  The Cabinet management also provided initial cost estimates for the last two fiscal years for utilities. Data on actual expenditures for each of the preconstruction phases were available through the MARS system. For each project these two values were computed and then analyzed by district and work type. Exhibit XI-4 and Exhibit XI-5 show the corresponding results. In analyzing cost escalation during the preconstruction process it was observed that the utilities phase was being over budgeted.

Exhibit XI-4: Authorized and Actual Expenditures for Utilities by District

	Utilities		
District	**Authorized ($)**	**Actual ($)**	**Variance (%)**
1	3,650,000	996,235	-73
2	1,070,000	511,987	-52
3	1,585,000	937,286	-41
4	5,770,000	5,485,802	-5
5	10,350,000	8,123,424	-22
6	4,733,050	1,323,889	-72
7	21,926,000	5,105,647	-77
8	1,760,000	997,013	-43
9	3,700,000	1,091,644	-70
10	2,875,000	973,686	-66
11	1,365,000	1,081,073	-21
12	11,150,000	5,475,441	-51
Total	**69,934,050**	**32,103,127**	**-54**

Source: MARS, Six-Year Highway Plan.

Exhibit XI-5: Authorized and Actual Expenditures for Utilities by Type of Work

	Utilities		
Type of Work	**Authorized ($)**	**Actual ($)**	**Variance (%)**
Highway Modernization	56,173,550	27,187,497	-52
Bridge Modernization	13,595,500	4,832,316	-64
Pavement Preservation	---	---	
Bridge Preservation	200,000	60,618	-70
Other	15,000	22,696	51
Total	**69,984,050**	**32,103,127**	**-54**

Source: MARS, Six-Year Highway Plan.

After analyzing the data, utility costs were found to be significantly over budgeted. The MARS system tracks encumbered costs. These are costs that are expected to be incurred but have not been expended. After adding these costs to actual expenditures, the results remained the same – there was a significant over budgeting for utilities. The Cabinet does not track all expenditures on utilities. The Cabinet management explained that it is common for utility contracts to be signed during the preconstruction process and paid at a later time using funds from the construction phase.

Despite the major financial, environmental, and schedule risks associated with incomplete or inaccurate data regarding the existence and location of utilities, the Cabinet has not attempted to mitigate this risk through state of the art technology. State departments of transportation, including those of Virginia, Florida, North Carolina, and Maryland, are using, to varying degrees, Subsurface Utility Engineering. Subsurface Utility Engineering is able to designate with precision the location of subsurface utilities with this minimally invasive technology developed in the late 1970s and adopted by the Virginia Department of Transportation as a standard tool in 1985.

Subsurface Utility Engineering is used in the design phase of project development to avoid the conflicts with existing utilities that would necessitate their relocation. Often, by slightly shifting the alignment of a project, thousands, if not millions of dollars can be saved. Moreover, it is clearly preferable to know the location of utilities in the design phase to optimally work around them; this also avoids the even more expensive delays and overruns that occur when utilities conflicts are not discovered until well into the construction phase.

The Federal Highway Administration has taken an active role in supporting the development and application of Subsurface Utility Engineering. Several case studies have been posted on its web site that illustrate the magnitude of cost savings

that can be achieved through use of this relatively inexpensive technology.[2] For instance, the Florida DOT analyzed the use of Subsurface Utility Engineering on major projects in Tallahassee and Miami and found that it saved $3 million in contractor construction delay claims for every $1 million spent on subsurface utility engineering. In a case study from the Maryland State Highway Administration involving realignment and widening of a highway from two to six lanes, Subsurface Utility Engineering was used to redesign the hydraulics system with an eye to minimizing conflicts. Instead of impacting 5,000 feet of each utility (gas, water, and sanitary), conflicts were reduced to about 400 feet. Cost savings to the utilities and the state were estimated at $1.3 million, whereas the cost of using Subsurface Utility Engineering was only $54,000.

- **The system that the Kentucky Transportation Cabinet uses to track the status of the utilities design and relocation process is rudimentary.**

  The Cabinet's Utilities Status Report is not integrated with the Division's Right of Way Status Report (despite these functions' co-dependencies), nor is it integrated into the Six-Year Highway Plan Status Report which is used to track other aspects of preconstruction.

  Utilities clearance is on the critical path to project delivery and is a frequently cited cause of project overruns and delay. Moreover, the magnitude of these overruns is significant. Any preconstruction management system that fails to integrate the utilities function is missing a critical aspect of project delivery. As the Cabinet strengthens project delivery management, it will be important for project managers to be managing schedule and budget for all preconstruction activities including utilities and right of way. This will require a better tracking system.

- **The actions of privately owned utilities, over which the Transportation Cabinet has no direct control, are causing project delays.**

  Privately owned utilities in Kentucky must bear the costs of engineering utility relocations as well as the physical construction thereof. Private utilities' own financial shortcomings, combined with an increased Cabinet program, have made it more difficult for these utilities to relocate their facilities in a timely fashion.

  The responsibility for the design and physical relocation of utilities necessitated by a highway project is borne by private utilities. The Cabinet has found it increasingly difficult to motivate private utilities to perform the relocation engineering and relocations in a timely fashion. The Cabinet Right of Way and Utilities managers believe the utilities' own financial pressures are part of their unpredictable response time. Another factor has been the recent growth in the program. The size of the Cabinet's program has no relationship to utilities' resources for relocation; therefore, utilities are struggling to keep pace with the Cabinet's program delivery.

[2] Available: http://www.fhwa.dot.gov/programadmin/case.

In the short term, projects that are added to the Six-Year Highway Program at the last minute (for instance to utilize a particular funding source) are problematic from the utilities' perspective because they will not have budgeted for them.

- **The Kentucky Transportation Cabinet's Procedures Manual for Utilities and Rail is out of date.**

  The current documentation consists of a set of unbound Utilities Memoranda dating from 1985 through 2003. Given the Cabinet's difficulty in recruiting and retaining qualified right of way and utilities staff, every effort should be made to provide new and existing employees with a reliable, complete, and accessible guide to their jobs. The current state of the Utilities Manual was recognized as a problem by the Utilities Process Blitz Team of 2001, which recommended updating this document.

- **Central office decision-making may be causing delay for the districts.**

  The Cabinet's Central Office retains authority to approve virtually any agreement a district enters into with a landowner or utility. Although this approach has the advantage of ensuring consistency and policy adherence, it has the disadvantage of increasing delay and inefficiency.

  Despite the general advantages that Central Office oversight provides, managers in the districts feel that the Cabinet's overall business processes for right of way and utilities need to be considered in depth—taking into account areas in which districts could exercise more authority to streamline the process without losing overall consistency and coordination.

E. Recommendations

1. Recommendation XI-1: Update and maintain Right of Way and Utilities Policies and Procedures Manual and integrate into project delivery.

The Utilities Manual is nearly 20 years out-of-date and has been superceded by a series of unbound Utilities Memoranda, some dating back to 1985. These memoranda, as well as other key Cabinet references and training materials, should be maintained online.

Although the Cabinet's Right of Way Manual is up-to-date, it is dense and reader unfriendly. In addition, it does not clearly relate the right of way function to overall project delivery. Given the Cabinet's difficulty in attracting and retaining right of way staff, it is important that new staff, and staff with new roles, have a single source for concise and correct information on how to proceed. Having an up-to-date Right of Way Manual is also important in ensuring that the Cabinet's policies and the Uniform Act are applied consistently across the districts. Such guidance could also reduce the need for Central Office oversight, which has been cited as an impediment to timely right of way clearance.

2. Recommendation XI-2: Develop an outsourcing strategy for right of way and utilities work.

Frustration with the quality and efficiency of outsourcing in the areas of right of way and utilities was expressed frequently—at both Central Office and district levels. However, the Cabinet has not developed a strategy, including goals and objectives, for its outsourcing. Therefore, the Cabinet should establish policy and procedures regarding:

- What to outsource.
- When to outsource.
- How to outsource (e.g., including how to direct, evaluate, and manage consultants in terms of policies, procedures, and even data formats to increase quality).
- How to measure the success and efficiency of outsourcing in these areas.

3. Recommendation XI-3: Improve or replace the home-grown right of way and utilities tracking systems.

The existing (separate) systems provide Right of Way and Utilities staff very little ability to manage the many real estate and utilities transactions under their review. These systems provide the project manager with very little information on the schedule status of these key project functions. The project status reports are not updated consistently, and this information is not tied in with the Six-Year Highway Plan Status Report system in the Oracle database. As a result, project managers must make individual requests to right of way staff, who then must run ad hoc queries to learn the status of particular right of way information.

Several preconstruction branch managers in the districts noted that tying the right of way status report in with the Oracle database would be very useful. The fact that these systems do not talk to one another is a barrier to effective project delivery.

4. Recommendation XI-4: Use Subsurface Utility Engineering to better locate utilities.

This recommendation calls for the Cabinet to evaluate the likely costs and benefits of deploying Subsurface Utility Engineering in the context of the state's existing engineering practices, expertise, and physical characteristics. The following approach to implementation is recommended:

- Establish a Subsurface Utility Engineering engineer in the utilities section to participate in decisions regarding which projects to apply Subsurface Utility Engineering to.
- Develop a roster of prequalified consultants.

- Develop business procedures around Subsurface Utility Engineering products (e.g., what are the required elements of consultant submissions and how are they to be reported for project use). These may include the following:
  - Utilities owners lists.
  - A Subsurface Utility Engineering legend defining all quality levels of information in the project (can range from A [best] to F [worst]).
  - Show proposed roadway alignment and construction limits.
  - Include the existing topography.
- Work with FHWA and other Subsurface Utility Engineering users to exchange information on lessons learned and state of the practice.

5. Recommendation XI-5: Establish incentives to induce privately owned utilities to relocate their facilities in timely fashion.

Privately owned utilities are reported by the Kentucky Transportation Cabinet management as struggling to keep pace with the Cabinet's higher levels of program delivery. Some utilities cite the financial burdens they face as constraints on delivering all of the relocations for which they are responsible. Both incentives and disincentives should be used to reduce delays and the attendant cost overruns associated with slow utilities relocations.

Incentives could include paying part of the costs of utilities relocation. For instance, the Cabinet might pay for (or contribute as in kind services) the engineering required prior to physical relocation. The utility would be responsible for the cost. The approach is not unprecedented; it has been used with some success in Maryland. Though this approach would involve additional costs for the Cabinet, it would improve its control over the project delivery process.

Disincentives include enacting a law to put a time limit on utilities for addressing their relocation requirements. Kentucky statutes on utilities relocation are silent on the specification of timing or any other requirements for relocations by privately owned utilities. Therefore, the Cabinet is "at the utility's mercy" with regard to a critical path project delivery item. Statutory change to compel utilities to relocate their facilities in some specified fashion would improve the Cabinet's ability to control the pace of its expenditures and the incidence of utilities-related contractor claims. To implement the recommendation, the enabling legislation and business practices in Wisconsin provide a good example because Wisconsin has been recognized as a best practices leader in the area of enabling legislation that can be used to reduce schedule and cost delays associated with utilities relocation as reported in a recent AASHTO publication entitled "Right of Way and Utilities Guidelines and Best Practices". In Wisconsin, state statutes provide structured guidelines and sanctions for utility companies' timely cooperation with the state department of transportation on relocation issues. They also

provide enabling legislation to provide utility companies with interest free loans so that they can pay for the needed relocations in a timely manner. The Wisconsin statutes in question are Section 84.063, and 84.065. The first, Section 84.063, pertains to the scheduling coordination of utilities relocation work in conjunction with state highway projects. This statute codifies a specific set of business processes and regulations around the Wisconsin Department of Transportation (WisDOT) and the private utilities companies. This process can be summarized in 5 steps, as follow:

- "If a facility is within the right of way of a proposed highway improvement, the department shall identify the owner and notify the owner in writing of the proposed improvement."
- "Within a specified period after the date the notice is received, the utility facility owner shall provide the department with a description and the general location of each utility facility in the proposed highway improvement right of way." (The legislation does not specify the length of the period in which the utility must provide this information. That is because the reasonableness of the period required may vary so widely, depending on the project's location, scope, complexity, and length. Another complicating factor is the existence of multiple utilities, whose separate relocations must also be coordinated.)
- "If the utility facility owner provides the information required under [sub. (2)], the department shall send the utility facility owner at lest one set of available project plans for the proposed highway improvement, including the location of the owner's existing utility facilities."
- "Within a specified period after receiving the project plans, the owner shall provide the department with a work plan." Among the items to be covered in the work plan are the following: a copy of project pans verifying the location of all of the owners' existing utility facilities and identifying the owner' proposed location of relocated or additional utility facilities; a plan and schedule of working days necessary to obtain any approval required by a governmental agency.
- The department reviews the work plan and upon conferring all necessary approvals, the utility company is notified by the department of the date on which it may proceed with its relocation work.

The mechanism with which WisDOT is empowered to enforce the utility's work plan is found in Section 84.603(4)-2: "If the utility owner fails to comply with the provision of the law that requires it to provide a detailed work plan, "the department or its contractor shall not be liable to the owner for damages to a utility resulting from the highway improvement…and the owner shall be liable to the department or its contractor for damages resulting from the failure to comply." In short, this section, 84.063 sets forth a standard procedure for agency/utility coordination as well as a "stick" that it can use to keep from being at the utility companies' mercy.

The Wisconsin state statutes also provide an incentive to timely utility relocation. Section 84.065 enables WisDOT to negotiate interest free loans to private utility

companies so that they can pay for the required relocations. This is an important provision because utility companies' capital budgets are often inflexible relative to WisDOT's ability or need to accelerate a project prior to the utility's next budget cycle.

6. Recommendation XI-6: Involve right of way earlier in the project delivery process.

One of the advantages of gaining early and continuous right of way input is saving costs and time by reducing the need for redesign. District right of way staff are best positioned to help project teams anticipate and address issues relating to likely right of way conflicts and cost impacts of alternative alignments. Often by simply avoiding certain pieces of real estate, the Cabinet can achieve cost and time savings.

Another advantage of gaining early and continuous right of way input is that it allows for more concurrent work on design, utilities, and right of way tasks. To the extent that project tasks can be done concurrently, as opposed to sequentially, problems can be identified earlier and overall project cycle time reduced.

Improvements that should be considered for implementing this recommendation include providing payments to owners sooner after deeds are signed, begin the appraisals earlier in the acquisition process, and limit the amount of time to complete negotiations (these were all previously identified improvements that have not been implemented).

XII. Construction Equipment and Light Vehicles Asset Management

■

This section evaluates the extent to which the Kentucky Transportation Cabinet performs asset or life cycle management for the medium- and heavy-duty road construction equipment and light vehicles that it is responsible for. Two divisions of the Cabinet are responsible for managing vehicles and equipment:

- The Division of Equipment which oversees the management of construction equipment, utility trucks, several hundred mowers, and ancillary equipment used primarily for road maintenance.

- The Division of Fleet Management which is responsible for the oversight of passenger cars and light trucks operated by various agencies throughout Kentucky state government.

This review is focused narrowly on whether these divisions are applying best management practices to perform life cycle and asset management on vehicles.

The questions evaluated are:

- **Question 1:** Does the Division of Equipment use best management practices in the planning, budgeting, and management of vehicles and equipment?
- **Question 2:** Does the Division of Fleet Management use best management practices in the planning, budgeting, and management of vehicles and equipment?

In answering both questions, it is important to note that this review evaluated the extent to which best management practices are in place, but did not provide a quantitative evaluation of the outcomes.

A. Background

1. Asset and Life Cycle Management for Highway Equipment and Vehicles

In simplest terms, asset management considers the total life cycle costs of the capital assets owned or used by the Cabinet as well as the value derived from their use. This approach differs from traditional governmental management which tends to separate capital planning and budgeting from maintenance and operations budgeting.

Best management practice for vehicles and equipment is to perform life cycle planning, budgeting, and management of these assets. There are many models of asset

ownership, including lease, purchase, and rent. The key assumption for this review is that asset managers own the equipment they manage, as is the case with the Cabinet.

Life cycle management for equipment involves the following elements:

- A set of documented standards and expected service levels for equipment performance such as in-service hours and performance effectiveness.
- A plan and annual budget for maintaining equipment that address preventive maintenance and repair maintenance.
- An acquisition and disposal plan and budget to determine the inventory of vehicles and equipment required to provide specific levels of maintenance service. For example, snow and ice clearance policy determines overall plow equipment requirements.
- An information management system for recording, analyzing, and reporting on asset performance, maintenance work, and organizational expenditures for each piece of equipment.

2. Key Characteristics of Effective Life Cycle Management Programs

Life cycle asset management considers the entire time the owner or manager controls an asset, from procurement through use to disposal. The following are indicators that managers consider the asset's life cycle as part of their management duties:

- **Procurement**

  Equipment managers select equipment based on the total cost of ownership of alternative assets, including procurement costs, operating and maintenance costs, and disposal costs. Some best practices involved with procurement under a life cycle management program include:

  - Purchasing equipment based on best cost.
  - Establishing criteria for selecting vehicles and equipment based on customer requirements.
  - Determining purchase points based on new equipment costs versus maintaining current fleet.
  - Leasing or selling idle equipment.

  These practices help to match the size of the fleet to the needs of the customers, increasing the overall utilization of fleet equipment and vehicles.

  Exhibit XII-1 below presents a simplified example for determining which alternative products to purchase, based on the total life cycle costs of each alternative. Under a low bid purchasing rule, the buyer must purchase

Alternative A; however, the total cost of ownership would be higher than if the buyer purchased Alternative B. Pursuing best practice, the Cabinet would choose Alternative B. This example is somewhat simplified because some management strategies such as standardization and bulk purchases with single vendors enable economies of scale in maintenance; however, under best practice these strategies are part of a life cycle management approach.

Exhibit XII-1: Notional Example of Purchasing Based on Total Cost of Ownership

	Alternative A ($)	Alternative B ($)
Purchase/Bid Price (expressed as present value)	5,000	8,000
Operating Costs (annual)	1,500	1,600
Maintenance Costs	2,000	1,000
Life Span	10 years	12 years
Subtotal	40,000	39,200
Disposal or Salvage Value	(0)	(1,000)
Total Cost of Ownership	**$40,000**	**$38,200**

- **Operations and Maintenance**

  The costs to operate and maintain equipment increases as equipment ages. Effective asset managers monitor equipment performance to identify when projected equipment maintenance and operating costs over a fixed future period will become greater than the cost to procure and operate a newer piece of equipment.

  Activities involved with effective life cycle maintenance include:

  - Managing preventive and routine maintenance programs.
  - Establishing a performance goal for equipment or vehicle utilization and downtime (overall equipment availability).
  - Tracking of equipment and parts inventory, their costs, and consumption.
  - Tracking of mechanic (and sometimes operator) labor costs to individual equipment.
  - Tracking parts and material expenditures for maintaining individual equipment.
  - Effective warranty management such that the Cabinet is getting reimbursed for all warranty eligible repair work.

- **Disposal**

  Effective life cycle management programs also look at the disposal value of the equipment. Best practices for disposing of equipment include establishing and following a set of replacement criteria, based on total equipment operational

hours, miles driven, or age. The criteria should be unique for each type or classification of vehicles and equipment.

- **Cost Recognition and Recovery**

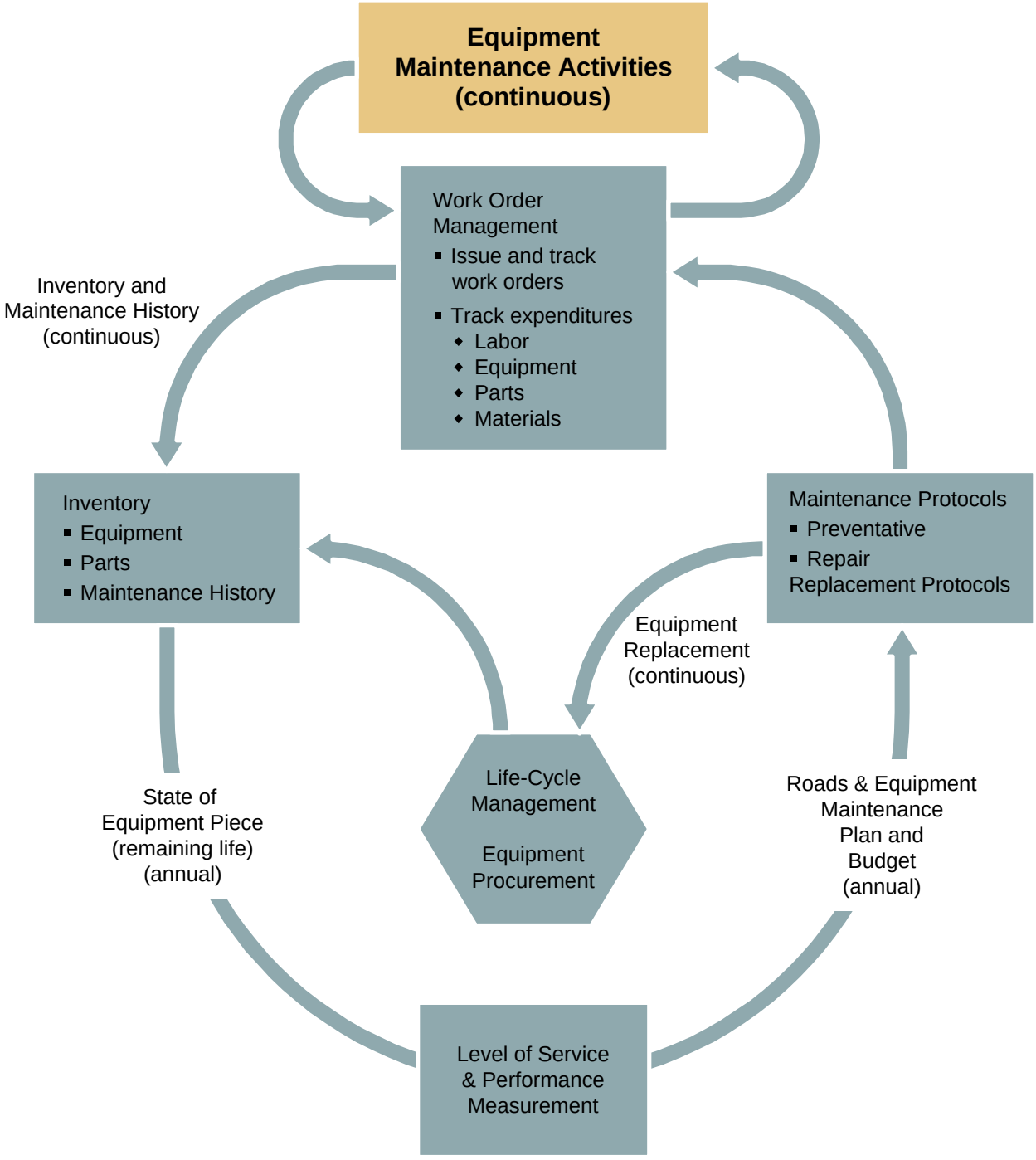
  Effective asset management requires full cost recognition for the use and ownership of equipment. If a division requests maintenance equipment, for example, the full cost of the equipment, including the cost of capital and operation and maintenance, needs to be borne by the users so they make effective decisions about using the equipment. Best practice involves the recognition of all costs associated with the equipment, including procurement, operations and maintenance, depreciation, and salvage. The rates charged and collected from the equipment users should provide sufficient income to make the equipment management organization self-sufficient. The established rates should vary according to type of equipment, and include factors for the expected use of the asset over a fixed period.

- **Management Information System**

  Asset management requires access to information on the condition, maintenance history, and operating costs and performance of equipment. Managers use information tools to optimize the use of assets and minimize the overall costs. A typical asset management system tracks asset operational and maintenance histories, the costs and volumes of consumed parts and supplies, maintenance work orders, ownership costs (procurement and operating costs such as fuel and operating labor, insurance, disposal, and depreciation), physical condition, and characteristics of each asset.

  Exhibit XII-2 illustrates the ongoing process for managing capital assets. It requires active management by the equipment or vehicle managers. Their job is to provide vehicles or equipment at the least cost to customers in the Cabinet, mainly the district maintenance forces. While this section addresses vehicles and equipment, the same general principles apply to other capital assets owned by the Cabinet, including buildings, as addressed in Section XIII, and roadways and bridges.

Exhibit XII-2: Life Cycle Management of Equipment Assets



3. Construction Equipment and Vehicle Management by the Transportation Cabinet

Two divisions within the Cabinet are responsible for light vehicles and construction equipment: the Division of Equipment and the Division of Fleet Management.

a. Division of Equipment

The Division of Equipment is within the Office of Construction and Operations and it manages medium and heavy-duty equipment for the Cabinet. This equipment is used to maintain roads, bridges, signs, guardrails, and right of way property of the Kentucky highway system.

Exhibit XII-3 illustrates the diverse array of equipment and vehicles managed by the division. Overall, the division is responsible for managing over 2,700 pieces of high valued equipment. In addition, the division manages hundreds of light pieces of equipment, such as lawn mowers, concrete saws, air compressors, and attachments (plows, material spreaders).

Exhibit XII-3: Transportation Cabinet, Division of Equipment Assets, 2003

Heavy Weight		Medium Weight	
Type	**Number**	**Type[a]**	**Number**
Backhoes	155	Dump Trucks	966
Dozers	9	Light Trucks	302
Excavators	47	Medium Trucks	101
Graders	142	Utility Trucks	96
Loaders	254	Trailers	225
Rollers	86	Semi-Trucks	20
Tractors	441	**Total**	**2,844**

[a] Light trucks are 1 to 1.5 tons in weight. Medium trucks include 2.5-ton trucks. Tractors may include some mowers. Loaders includes fork lift trucks.

Source: The Kentucky Transportation Cabinet Division of Equipment's Equipment Management System, Dye Management Group, Inc. analysis.

These vehicles and equipment are assigned to Division of Operations and Division of Traffic personnel for use in maintaining the state highway network. The total purchase cost of all the equipment managed by the division is almost $123 million.[1] The replacement cost would be substantially more.

[1] Kentucky Transportation Cabinet Division of Equipment's Management System.

b. Division of Fleet Management

The Division of Fleet Management is within the Department of Administrative Services. The division owns and manages a fleet of light vehicles (passenger cars and trucks less than 1 ton) for many customers throughout the Cabinet and other Kentucky government agencies. Exhibit XII-4 below shows the breakdown of the fleet managed by the division, as well as its estimated value. The division manages buses for the Cabinet's Human Service Transportation Delivery program.

Exhibit XII-4: Transportation Cabinet, Division of Fleet Management Vehicles, 2003

Type	Number	Total Replacement Cost (in $000s)[a]
Passenger cars	1,531	25,170
Vans	505	10,590
Light Trucks	2,371	47,240
Buses	17	670
Total	**4,424**	**$83,670**

[a] Estimated.

Source: The Kentucky Transportation Cabinet Division of Fleet Management, Dye Management Group, Inc. analysis.

The division manages around 4,400 vehicles for various state agencies. It is estimated that a further 6,000 vehicles owned by other agencies are not managed by the Division of Fleet Management. The vehicles are assigned to various state agencies, based on the individual agency's needs and available budget. The same state agency may rent different types of vehicles depending on its location in the state (passenger sedans in the western portion of the state, SUVs in the mountainous areas).

B. Division of Equipment

Question: Does the Division of Equipment use best management practices in the planning, budgeting, and life cycle management of construction equipment?

1. Answer

Yes, the Division of Equipment is aggressively pursuing life cycle management practices to ensure that the Cabinet has an effective fleet of equipment for maintaining the Kentucky highways. The Division of Equipment has the following best management practices in place:

- Selects and purchases equipment based on best value that includes life cycle and other costs of ownership.

- Tracks life cycle cost information for each piece of equipment using an equipment management system.
- Establishes standard policies and procedures for conducting preventive and routine maintenance.
- Establishes replacement schedule for heavy and medium equipment; however, fiscal constraints have prevented fully implementing this best practice.
- Maintains a rental rate structure for equipment that includes the full cost of ownership, operation, and disposal.

2. Analysis Strategy

Our analysis approach involved the following steps:

- Conducted interviews with employees to identify documented policies and determine actual practice.
- Assembled and evaluated data from the equipment management system.
- Assessed the Cabinet against best management practices drawing on Dye Management Group, Inc.'s prior best practices analysis.[2]

3. Findings

- **The Division of Equipment selects and purchases equipment based on best value and life cycle cost considerations.**

  A best value approach to procurement ensures that the equipment procured from selected vendors meets several life cycle management criteria, including technical capabilities and overall life cycle cost (ownership, operating, maintenance, and disposals) and warranty coverage.

  The Cabinet has established Master Agreements with equipment vendors and manufacturers through the Finance Cabinet to select and procure equipment. These master agreements are established after scoring each vendor through best value criteria, including:

  – Product capabilities (meets technical requirements and specifications).
  – Training tools provided for product maintenance and operation.
  – Warranty period.

[2] Utah Department of Transportation, Fleet and Equipment Management Performance Audit, Dye Management Group, Inc., 2001.

- Price per unit.
- Vendor capabilities and qualifications.
- Past vendor service response times.

Using these multiyear agreements has an added benefit of providing some commonality and uniformity to the equipment fleet. When selecting and purchasing equipment each year in an open competition, based on low bid, fleet managers end up with a fleet of equipment consisting of several makes and models. A fleet of diverse equipment types drives up fleet ownership costs through the following diseconomies: a larger inventory of parts, more mechanic training time, and longer repair times due to the mechanic's relative unfamiliarity with the vehicles (a common set of equipment means that mechanic's spend more time with the same type of equipment).

In addition, the division has established multiyear rental or lease agreements with local vendors throughout the state to provide the Cabinet with any equipment needed on a short-term basis. These rental agreements have fixed hourly, daily, weekly, or annual rates, depending on the vendor, and include operator, fuel, and transportation costs.

- **The Division of Equipment tracks life cycle cost information using the Equipment Management System.**

  Good life cycle asset management includes tracking operational data to optimize equipment usage (reducing repair downtime and idle equipment), noting when operational characteristics fall outside normal parameters or when maintenance costs increase. Keeping track of individual equipment operational data and maintenance history allows fleet managers to make decisions based on actual equipment history and performance.

  The division tracks all aspects of equipment operation and maintenance using the Cabinet's Operations Management System (assessed in more detail in Section VIII). The system tracks and maintains the following data required to perform life cycle management:

  - Repair histories (activity, date completed, out of service date, who performed the repair, and the labor and material costs).
  - Mechanic labor costs.
  - Parts and supply consumption history (fuel, tires, repair parts, etc.).
  - Physical condition, location, inspection dates.
  - Technical and operational specifications (make, model, engine size, odometer, capacity, etc.).

- Financial and cost data (original value, useful life, purchase date, rental rates, warranties, insurance requirements).

All costs are linked to the district where the equipment is assigned.

- **The Division of Equipment has established standard policies and procedures for conducting preventive and routine maintenance.**

  Effective fleet managers establish procedures for regular inspections and standardized preventive and routine maintenance schedules. Following best practices, the division has assigned maintenance personnel to garages at equipment depots which provide the division with daily access to equipment to complete the needed routine and preventive maintenance. The division's maintenance activities include routine inspection to ensure the fleet operates within the specified guidelines set by manufacturers.

  Equipment Supervisors identify when routine maintenance is required based on operating records kept for each piece of equipment and recorded in the division's management information system. If mechanics cannot perform repairs locally, the equipment is shipped to the Central Office facility, or to an outside repair facility certified to conduct the work. Data on equipment and subsystems warranty is maintained in the equipment management information system.

  Applying the maintenance practices noted above, the division monitors equipment performance closely. If particular pieces of equipment have higher than expected maintenance or operating costs, they are flagged for special attention including notification to the manufacturer or vendor of problems, maintenance reviews, and disposition of equipment warrantees. As a result, the division does not maintain equipment that has not lived up to specification, thus saving the Cabinet money because it does not have to maintain equipment that is inefficient, ineffective, or poorly designed.

- **The Division of Equipment has established a replacement schedule for heavy and medium equipment that reflects best management practice.**

  Historically, many organizations kept equipment until each piece was past its useful economic life. For heavy construction machinery, this could take 20 years or more, well past the point where the equipment is fully depreciated and still useful or saleable in the secondary market.

  As a best management practice, equipment managers establish and follow replacement cycles that involve selling their equipment before it costs more to own and operate than it costs to buy new equipment, amortizing the depreciation. The best practice is managing and replacing individual pieces of equipment before the cost of ownership exceeds the replacement costs.

The Equipment Committee of the Division of Equipment conducts such an analysis to establish an equipment replacement schedule. The division uses the replacement criteria as guidelines. The division follows the Kentucky Administrative Regulations regarding sale of equipment (the Finance Cabinet is ultimately responsible for sale and disposal of Kentucky government assets). Due mainly to budgetary constraints and procurement rules, the Division of Equipment has not been able to replace equipment when it meets the replacement schedule criteria. However, the Division has completed a study determining which equipment has the highest priority for replacement based on Cabinet strategic goals and mission.

- **The Division of Equipment has established a rental rate structure for equipment that includes the full cost of ownership, operation, and disposal.**

  Establishing true cost recognition so that the price mechanism supports the efficient allocation of resources is a key element for effective asset management of highway equipment. Best life cycle management includes recovering all the costs involved with providing equipment to customers. The Division of Equipment applies this practice through equipment rental rates established by the Cabinet for each type of equipment that include the following costs:

  – Procurement (specification development, purchasing, receiving, customization).

  – Operations and maintenance (mechanic labor, parts, fuel).

  – Overhead (utilities, insurance).

  – Depreciation and disposal.

  The rental rates are reviewed by the Equipment Committee on a regular basis to ensure that future revenues will match division expenditures.

  The rate structure also includes a minimum monthly fee, which allows significant predictability in the amount of revenue generated by the equipment rented by the division. Any expenditure over the monthly fee is collected on an hourly basis (for every hour the equipment is used over the minimum). By having predictable revenues, the Division of Equipment is more effective in planning short-term (one year) expenditures and equipment requirements.

C. Division of Fleet Management

Does the Division of Fleet Management use best management practices in planning, budgeting, and life cycle management of light vehicles?

1. Answer

Yes, within the constraints of the current vehicle replacement policy and the duplication of vehicle management functions in some Kentucky state agencies. The Division of Fleet Management employs life cycle management for procurement, for preventive and routine maintenance, and for setting rental rates. However, the Commonwealth maintains a single replacement schedule for all passenger vehicles types (Kentucky Administrative Regulation). Best management practices would involve establishing vehicle replacement guidelines for each class of vehicle based on actual life cycle cost experience.

Although the analysis focused on life cycle and asset management practices within the Division of Fleet Management, our fact finding identifies a number of statewide organizational issues about passenger vehicles that could result in cost savings. Two main issues warrant further study. First, the Division of Fleet Management is not managing all the passenger vehicles owned by state agencies, which results in a duplication of function across agencies and is a diseconomy of scale with no guarantee that contemporary fleet management practices are being applied. Second, given that Fleet Management is providing a support service to all state agencies, perhaps it should be located within another cabinet that has statewide responsibilities.

2. Analysis Strategy

Our analysis approach involved the following steps:

- Conducted interviews with Division of Fleet Management employees to determine actual practice.
- Assembled and evaluated data on the fleet.
- Assessed the Cabinet practices against industry best practice.

3. Findings

The characteristics and methods for following appropriate life cycle management for light vehicles are the same as those stated previously for heavy construction equipment.

- **The Division of Fleet Management identifies and purchases vehicles that are cost effective to the Commonwealth.**

  As a best management practice, fleet managers select and procure vehicles based on life cycle price and customer requirements, planning and budgeting purchases based on the expected level of service to be performed by the vehicles. Through regularly scheduled meetings with customers, the division keeps up to date on customer needs and identifies savings by selecting vehicles that fit the customer agency's mission.

  The Division of Fleet Management, in conjunction with the Finance Cabinet, uses master agreements for volume purchasing of light vehicles negotiated with national sales representation from manufacturers. The selection criteria for vendors on these master agreements are based on:

  – Product capabilities (meets technical requirements and specifications).
  – Training tools provided for product maintenance and operation.
  – Delivery schedule.
  – Warranty period.
  – Per unit price.
  – Vendor capabilities and qualifications.

  Through these agreements, the division has realized considerable cost savings in purchasing newer vehicles and reducing the average age of the fleet. In fiscal year 2003 alone, the division saved over $2.6 million (about 30 percent) off the manufacturers suggested retail price for 346 vehicles purchased from Ford and Chevrolet. The Division usually purchases between 700 and 800 vehicles per year, so annual savings could be higher. In addition, prices for several vehicles have been decreasing year to year for comparable models.

- **The Division of Fleet Management follows a replacement schedule set by the Kentucky Administrative Regulations; modifying the schedule will provide opportunities for cost savings.**

  The Kentucky Administrative Regulations (600 KAR 1:120) state that the division should consider replacing vehicles at 5 years, or 90,000 miles. The current policy is to replace the vehicles only if they have been driven 100,000 miles. As a best practice, many states use replacement criteria between 90,000 and 200,000 miles, depending on the type of vehicle. Variable replacement criteria provide fleet managers the ability to more fully utilize vehicles, extending the service life of equipment and spreading the cost of purchasing vehicles over a longer period (lower depreciation expenses).

- **The Division of Fleet Management has established a sound program for tracking and managing preventive and routine maintenance for light vehicles.**

  Many manufacturers and vendors establish life cycle maintenance programs and schedules for light vehicles, such as when to perform routine and preventive maintenance (oil changes, fluids, change tires, complete tuneups, etc.).

  The division's maintenance program includes:

  – Providing in-house maintenance for vehicles located in the Capital region.

  – Maintaining a call center and help desk for vehicle leasing customers throughout the state.

  – Certifying private repair garages to perform vehicle maintenance activities.

  Maintenance costs are recorded and tracked using management information tools and data from vendors and the field. If the costs on a vehicle exceed expectations, analysis is done to identify any problems.

  As a practice, the division tracks individual vehicle usage and lets the drivers know when the vehicles are due for maintenance. Communications between the users and the division are maintained through a help desk (accessible toll-free), managed and operated by division staff.

- **The Division of Fleet Management applies a rental rate structure that includes the full cost of ownership, including purchase, operation, and disposal.**

  Best life cycle management include recovering all the costs of providing fleet vehicles to customers. The division recovers the costs of managing the fleet through a rental rate paid out of each Kentucky agency's operating budget. The rental rate applies a fixed minimum monthly fee based on the type of vehicle operated by the customers, plus a variable amount based on miles driven over a base amount. The rate developed for each type of vehicle incorporates the general operating costs for purchase, maintenance and parts, depreciation, insurance, and replacement at the end of its service life.

Exhibit XII-5: Cost Recovery Performance from Renting Equipment by the Kentucky Transportation Cabinet Division of Fleet Management

	FY2000 ($)	FY2001 ($)	FY2002 ($)	FY2003 ($)
Budget (Appropriation)	29,164,000	23,947,000	30,912,000	30,193,000
Expenditures	29,120,000	20,018,000	23,279,000	21,332,000
Rental Revenues	20,690,000	24,170,000	28,090,000	25,389,000
Cost Recovery	(8,430,000)	4,152,000	4,811,000	4,057,000

Source: Kentucky Transportation Cabinet, Division of Accounts, Dye Management Group, Inc. analysis.

The exhibit shows that the division has funds for operating and managing the light fleet. Effective life cycle management requires full cost recovery for vehicle operations. Our analysis did not consider the overall efficiency of these practices to determine if rental rates could be lowered. Such analysis would be the subject of a more detailed review.

- **The Division of Fleet Management tracks vehicle performance using two management information systems; problems with system architecture prevent accurate fleet analysis and reporting.**

  Life cycle asset management requires tracking operational data to optimize vehicle usage, noting when operational characteristics of the vehicle fall outside normal parameters and maintenance costs increase. Keeping track of individual equipment operational data helps fleet managers make decisions such as when to service equipment, when to replace, and when it is appropriate to purchase equipment from the same manufacturer.

  The division uses two software programs for managing fleet data. The division followed other Cabinet offices in implementing aspects of the Operating Management System; however, problems with the system currently prevent the division from fully utilizing the tool, including its inability to read legacy data and to track vehicle performance measures based on odometer readings, a key field used by vehicle managers. Therefore, the system contains many errors. To track historical vehicle performance, managers archive the data as time permits on a weekly or monthly basis, and feed the data into a stand-alone database using Microsoft Excel.

D. Recommendations

The following actions are recommended to improve life cycle asset management of vehicles and construction equipment in Kentucky.

1. Recommendation XII-1: Change Kentucky Administrative Regulations regarding equipment procurement authority to reduce equipment costs.

The objective of this recommendation is to make targeted changes to the Kentucky Administrative Regulations that will reduce equipment procurement costs and increase equipment in-service time. The Kentucky Administrative Regulations establish the policies, procedures, and authority of state agencies in making equipment purchases. Review of the processes followed by the Division of Equipment and the Division of Fleet Management revealed that these divisions are hindered from incorporating some best life cycle management practices. For example:

- **The purchasing authority for local equipment supervisors is set at $2,000.**

  When a mechanic needs to replace a major component on a vehicle or piece of construction equipment and the cost exceeds $2,000, the Cabinet must submit a more time consuming purchase request through the Finance Cabinet. While this is relatively infrequent, it does happen occasionally and causes a specialized, high value piece of equipment to be idle in maintenance, reducing the overall productivity of the Cabinet's operational forces assigned to maintain the roads. Increasing the purchasing authority should prevent such delays in the future.

- **The process for purchasing used equipment from private vendors is delayed by review and approval.**

  The Division of Equipment has the authority to purchase used equipment. However, the independent appraisal and review process required by the Finance Cabinet and the Administrative Regulations can cause delays. Equipment sellers are not bound to hold the equipment so the Cabinet can purchase it at the end of the review period. The Cabinet misses opportunities to purchase good used equipment because the equipment is sold before the Finance Cabinet finishes its review.

The Cabinet may realize cost savings and improved service by reducing the delays caused by waiting for the appropriate approvals to make minor purchases. In addition, the Cabinet can avoid lost opportunities in purchasing used equipment. The Cabinet should consider establishing a master agreement for conducting independent appraisals. Under the agreement, when a piece of used equipment is identified that the Division of Equipment would like to purchase, the appraiser has a limited amount of time to send the report to the Cabinet and the Finance Cabinet for ultimate approval of the purchase.

This recommendation may require changes in both Kentucky Administrative Regulations and Kentucky Revised Statutes.

2. Recommendation XII-2: Review and, where appropriate, change the replacement criteria for light vehicles.

The Kentucky Administrative Regulations (600 KAR 1:120) state that the Cabinet should use replacement criteria for vehicles based on five years or 90,000 miles. The Division of Fleet Management's current policy is to replace all vehicles regardless of type at 100,000 miles. This recommendation entails conducting a review of Kentucky's experience and establishing new fleet replacement criteria that minimize the life cycle costs by class of equipment. This analysis may find that Kentucky is replacing certain vehicle classes too soon and thus incurring extra costs.

To implement and apply best management practices, the replacement criteria should vary according to the type of vehicle. For example, in South Carolina, the following replacement criteria follow standard best fleet management practices:

Exhibit XII-6: South Carolina State Fleet Replacement Criteria

Vehicle Class	Minimum Miles	Age (years)
Full sized Sedans	100,000	6 – 8
All other sedans	90,000	5 – 7
All station wagons	100,000	6 – 8
Full sized vans	120,000	7 – 9
Minivans	100,000	6 – 8
SUVs	100,000	6 – 8
Fullsize Police Cruisers	100,000	4 – 6
All other Police vehicles	90,000	4 – 6
Trucks< 10,500 gwt	100,000	6 – 9
Trucks >10,500 gwt	100,000	7 – 10
Bus	120,000	9 – 12
Tractor Trucks	130,000	13 – 16
Trailers		15
Buses (diesel)	200,000	15

Source: South Carolina State Fleet.

3. Recommendation XII-3: Evaluate the feasibility and business benefits from implementing revolving funds for operating both the Division of Equipment and the Division of Fleet Management.

Although our analysis found no pressing management issues that this recommendation addresses, many states and most local fleet management agencies operate under a revolving fund account as a separate off-budget enterprise fund. Under this arrangement, these agencies have financial control over the entire fund, as the fund is there to ensure a sufficient fleet of vehicles and equipment in the near- and long-term. The Division of Equipment's budget for maintaining the equipment fleet is not fully restricted. The budget is zero-based, meaning that any shortfalls must be made up with Cabinet general funds, and any overcharges to the fund must be returned. In addition, funding levels provided by the Cabinet have not been sufficient to fully replace and maintain the average age of the fleet; the cost for new equipment has increased while the budget for equipment has not kept pace.

The purpose of this recommendation is for the Cabinet to assess the business case for implementing a fully restricted revolving fund for equipment and vehicles. In general, the benefits are that these funds accumulate capital across budget cycles to fund periodic purchases and are protected from diversion to meet general fund or other transportation needs. This business-based approach to financial management will give

the divisions more authority and responsibility for managing assets, while at the same time encourage fleet customers to be more efficient in the selection and use of their vehicles and equipment. However, this type of approach takes such purchases out of the overall budget-driven priority setting process.

4. Recommendation XII-4: Evaluate the businesses benefits of consolidating the management of all (non-exempt) light vehicles under the management of a single state agency.

Although the analysis addressed primarily life cycle management, this recommendation is to conduct a business case analysis for the consolidation of all light vehicle management in a single agency, possibly outside of the Cabinet, and to assess the extent to which current administrative rules are being followed. This recommendation addresses the current situation in which light vehicle ownership and management is distributed across a number of agencies.

Under 600 KAR 1:120, the Division of Fleet Management is responsible for managing the fleet of light trucks and passenger vehicles operated by several state agencies, including the Transportation Cabinet, Attorney General's Office, the Natural Resources Cabinet, Public Protection Cabinet, and Justice Cabinet. In total, the division manages over 900 lease agreements (each government office has its own lease agreement). However, during the course of the review, Division of Fleet Management staff informed us that there are a significant number of state-owned vehicles that are not managed by the division (upwards of 6,000) and that they do not believe that the administrative rules are always followed by state agencies. Because the Commonwealth has not had control of vehicle purchasing and maintenance centralized within the Division of Fleet Management at the Cabinet, it is very likely that there have been missed opportunities to save money through greater purchasing power (volume purchasing equals lower cost per unit), and lower cost (no-frills vehicles versus luxury models).

For example, the Division's use of standards and specifications for selecting vehicles sets up a mechanism to procure standard equipment (typically not the "high-end" version of models). Those agencies that are not following state procurement rules may be spending more money on non-standard vehicles.

The first step in this recommendation is to complete an inventory of all light vehicles purchased and used by the Kentucky State Government. The secretary of the Finance Cabinet wrote two memoranda (dated April 11 and May 9, 2003, respectively) covering the subject of fiscal policies to be implemented in the 2002-2004 biennium budget. In these memos, he specifically mentioned the need to reduce the number of vehicles owned and operated by the state. As a first step, agencies are to document and provide an inventory of their leased vehicles to the Cabinet. The subsequent memo clarified that permanently assigned vehicles would be inventoried separately from all "agency assigned" vehicles.

This inventory should include all vehicles used by all state or state supported agencies. Some agencies have not been following administrative rules to request vehicles exclusively through the Division of Fleet Management. While exceptions may be granted, there is concern that the process has been corrupted. In addition, lack of data available to the division prevents effective vehicle life cycle management.

The Kentucky Government may accrue savings through consolidation of several vehicle rental leases. The division currently maintains 900 lease agreements with other Kentucky government agencies, many for the same cabinet and department.

Exhibit XII-7: Top Ten Vehicle Leaseholding Agencies in Kentucky

Lease Holder (Office or Cabinet)	Number of Leases
Transportation	156
Public Protection and Regulation	136
Tourism	120
Justice	98
Governor's Office	64
Education, Arts, Humanities	54
Health	45
Workforce	37
Finance	35
Revenue	28
Total	**931**

Source: The Kentucky Transportation Cabinet Division of Fleet Management, Dye Management Group, Inc. analysis.

Consolidation of these leases into one lease for each department should reduce the overall management processing time consumed by the division in managing the fleet.

XIII. Transportation Cabinet Buildings and Facilities Life Cycle Management

■

This section presents our review of the Cabinet's management of fixed building facilities and property assets located throughout the state. The review evaluates how effectively the Cabinet is in managing the building and facility capital assets, using best management practices and applying life cycle management techniques.

The question evaluated is:

- **Question 1:** Does the Division of Property and Supply Services use best management practices in the life cycle planning, budgeting, and management of buildings and facilities (fixed plant)?

The scope of this review is the management practices used to manage buildings and other fixed assets. The review did not evaluate the performance of facility management activities themselves, the costs to maintain facilities, or the overall utilization of these lands and buildings.

A. Background

1. Facility Life Cycle Management

Overall, the procedures for managing and maintaining buildings and facilities are significantly different than those required for maintaining other capital assets such as vehicles and heavy construction equipment. Vehicle mechanics specialize in welding, automotive electronics, and motor mechanics. In contrast, building facility mechanics are trained in disciplines such as heating and ventilation (gas and electric boiler maintenance), plumbing and carpentry (walls and roofing), and masonry.

However, the best practices for life cycle management of building assets are similar to those for managing vehicles and heavy equipment. Facility managers, technicians, and custodians maintain and repair building infrastructure and subsystems; repairs are recorded and tracked by work order; and facility assessments are conducted on a routine basis. Maintenance occurs continuously, and preventive maintenance can extend the life of the facilities. As a best practice, managers will recognize and track all costs of operating and maintaining assets to ensure that life cycle costs are managed and decisions are based on sound financial information. Life cycle costs include the following capital, maintenance, and operating costs:

- Capital costs of purchasing and maintaining facilities.

- Costs for land, including principal and interest.
- Facility construction costs.
- Environmental remediation costs.
- Facility depreciation costs.
- Facility and land maintenance costs (labor, parts, materials).
- Facility subsystem costs.
- Utility costs.
- Property tax costs and the tax revenues lost by government due to public ownership.
- Management costs.

Knowing and understanding these costs help managers make important trade-off and planning decisions, such as when to buy and when to lease property, when to sell underutilized properties, when it is best to rehabilitate older properties and when it is best to tear down and build new, and when to select green-field and brown-field land facilities.

2. Division of Property and Supply Services

The Cabinet owns a large number of buildings and other capital facilities. The Division of Property and Supply Services provides the associated support services, including building and facility maintenance, interior design, and architectural services. Exhibit I-1, below, lists the number and type of buildings and facilities owned by the Cabinet.

Exhibit XIII-1: Summary of Lands and Buildings Owned by the Transportation Cabinet[a]

Type	Number	Area (sq. ft)	Initial Ownership Cost ($)[b]
Miscellaneous Buildings (including District Offices)	159	645,000	24,200,000
Salt/Chemical Storage Structures[c]	222	583,000	9,100,000
Shops and Garages	200	1,438,000	25,120,000
Storage buildings	348	446,000	3,610,000
Trailers	94	82,000	1,620,000
Weight Stations/Rest Areas/Inspection Stations	101	136,000	14,740,000
Subtotal	1,124	3,330,000	78,390,000
Land	264	2,556 acres	9,750,000
Total			**$88,140,000**

[a] This exhibit does not include the new Cabinet office building.

[b] This exhibit does not reflect the market value of the lands and buildings owned by the Kentucky Transportation Cabinet. The information is not available.

[c] Includes relocateable (temporary) salt storage buildings.

Source: The Kentucky Transportation Cabinet Division of Property and Supply Services, Dye Management Group, Inc. analysis.

Overall, the Cabinet owns and maintains over 1,100 buildings (over 3 million square feet of space), as well as over 2,500 acres of land.

B. Question 1. Does the Transportation Cabinet use best management practices in the life cycle planning, budgeting, and management of buildings and facilities (fixed plant)?

The principal issue is whether the Cabinet pursues best management practices in planning for and managing buildings and other fixed plant.

1. Answer

No, the Cabinet does not manage its buildings and other fixed plant using life cycle management practices. However, it has taken some steps to improve maintenance and recordkeeping. Property is not purchased or managed in a business-like manner; the different units within the Cabinet do not pay for the property that they use nor do they have mechanisms for accounting for building maintenance and operations costs that can be considered in management decisions. The cost of capital used in buildings and the associated operating costs are essentially paid as an administrative overhead and

not charged back to the users of the facilities. The Cabinet neither has a long-term capital facilities plan nor a short-term maintenance plan to guide budgeting and management practices. The Division of Property and Supply Services' current work order management system lacks the functional capability to easily and accurately track and report labor, tools, parts, or material expenditures. The Division of Property and Supply Services has a preventive and routine maintenance program, but because few performance measures are tracked, it is unclear how effectively the division manages the life cycle condition of buildings.

2. Analysis Strategy

Our analysis approach involved the following steps:

- Interviews with employees to determine actual practice.
- Analysis of data provided by the Kentucky Transportation Cabinet.
- Comparison to industry best practice drawing on best practice knowledge.

3. Findings

- **The Division of Property and Supply Services does not recognize or recover costs for maintaining buildings and properties for the Transportation Cabinet.**

  The Cabinet does not have a price mechanism for paying an internal service charge or other costs associated with property. Without such cost recognition, there is no price mechanism to provide an incentive for the Cabinet to operate and maintain capital facilities economically. Best management practice involves tracking and analyzing all costs associated with owning and operating facilities. The only cost data available for the Cabinet's buildings and facilities are the original purchase price and the labor and material costs for maintenance. The division maintains insufficient information for making appropriate life cycle management decisions.

  In addition, the ownership and upkeep of these buildings and facilities is paid directly out of the Cabinet's Road Fund. Individual Cabinet offices do not incur expenses from their use of buildings. There is no cost recognition or evaluation of life cycle costs of facility ownership. Consequently, there is little incentive to use the facilities in a business-like, efficient manner. For example, it is difficult for the Cabinet to make key business decisions, such as whether to own, lease, or sell specific properties.

- **The Division of Property and Supply Services' current work order management system lacks the functional capability to easily and accurately track and report labor, tools, parts, or material expenditures.**

  Best practices for facility management include recording and tracking maintenance work requests and work costs through a management information system. For widely distributed properties, a best practice for informing maintenance forces of a needed repair is through electronic/computerized communications.

  The Division of Property and Supply Services does not keep an accurate inventory of equipment, parts, or a centralized maintenance history of its facilities. The division has a legacy of managing facilities without computerized record keeping. For example, work order requests are communicated to the division by several methods, including voice and e-mail. Historical information exists only on paper, preventing effective management of cost information. This situation should improve in the future, as the division has begun implementing a management information system (Archibus/FM Building Operations Management), which can be used to support life cycle management of the Cabinet's properties. The Building Operations Management module can be used to:

  – Evaluate work order requests.

  – Develop work forecasts and budgets.

  – Track preventive maintenance activities.

  – Record and track condition assessments.

- **The Division of Property and Supply Services has a preventive and routine maintenance program; however, few performance measures are tracked, impeding effective life cycle management of buildings.**

  Best facility management practices include monitoring the condition of assets and maintaining critical systems before they fail or quickly repairing them after they fail. Facility managers establish maintenance plans to ensure that critical and non-critical systems remain operational, with minimum system downtime.

  The Division of Property and Supply Services has established maintenance protocols based on the training and the experience of their mechanical staff. However, because few performance measures and costs are tracked, it is unclear whether the division is effectively maintaining the life cycle condition of the Cabinet's buildings.

  The Division of Property and Supply Services' approach to prioritizing repairs is assessing whether a system is of primary importance to a building. If a building loses any one of the three utilities (water, heat, or electricity) the repairs take highest priority. Mechanics perform routine facility inspections to identify when

preventive maintenance is needed; in some cases, the manufacturer recommended inspection programs drive the schedule for maintenance.

In addition, mechanics perform routine and preventive maintenance on some critical facility systems, including heating and ventilation systems, water, and electricity. Otherwise, maintenance and repair is completed when a failure or break occurs. Building facility technicians conduct weekly inspections of facilities, identifying and completing any simple maintenance or identifying where future repairs will likely be needed. The Division of Property and Supply Services plans maintenance activities on a weekly basis. Maintenance schedules are based on inspection reports, work requests, and the results of past work. Maintenance work orders completed versus work orders received are tracked. There are several operational and maintenance measures used by the Finance and Administration Cabinet that would improve the management of the Cabinet's buildings and facilities.

- **The Division of Property and Supply Services does not have a long-term facilities management plan.**

  Best practices for capital facilities management include a long-term capital asset plan, matched to the organization's overall business plan and forecast of future activity levels and financial budgets. The Division of Property and Supply Services follows the overall Cabinet's budget process, looking out only one to two years; the division's budgets are based mostly on historical expenditures. Estimates are based on the building mechanic's knowledge of facilities and anticipation of future repairs.

C. Recommendations

1. Recommendation XIII-1: Establish a life cycle management approach for buildings and facilities.

The purpose of this recommendation is for the Cabinet to establish a systematic approach to capital planning and budgeting for facilities based upon the economic use and the full life cycle costs of owning and operating them.

To implement the recommendation the Cabinet should:

a. Institute a program for planning long-term facility requirements.

Activities that should be considered part of this plan include:

- An inventory and condition assessment of buildings and facilities.
- An Asset Management Plan for managing the real property owned by the Cabinet.

The plan will:

- Provide the strategic framework for the Cabinet's real property asset investment decisions.
- Develop a report showing the current overview of real property asset physical condition, functional operation, and cost.
- Identify multiyear performance and cost targets for operating expenses.
- Provide the Cabinet executives accessible to real property asset documentation.

The plan will also help the Cabinet make decisions about ways to reduce the costs of buildings and facilities. For example, the Cabinet has previously been encouraged to reduce the number of equipment workshops to 12 to match the number of districts. The overall review of the management and organization of the Cabinet includes a recommendation to consolidate the districts, perhaps to as few as six or four.

Additional long-range planning is required for some specialized facilities or subsystems. For example, in-ground fuel tanks are subject to considerable regulation; there are potential financial risks if there is no plan to deal with them.

b. Establish a program for collecting and using life cycle cost data for managing buildings and facilities.

The Division of Property and Supply Services is encouraged to implement a program to capture all life cycle cost information, including maintenance and operating costs, capital asset values purchase and depreciation, and the cost of capital to own the buildings and facilities.

Performance measures to track may include:

- Cost per square foot of owned and leased building properties.
- Capital costs incurred from owning specific properties.
- Cost per square foot of land.
- Operational costs per person.
- Average energy costs per square foot.
- Percentage of work orders completed within allocated time frames.
- Ratio of preventive work orders to reactive work orders.

The division may determine which facilities are more expensive to operate and maintain, or will note through historical tracking of facility costs that a facility is becoming too expensive to maintain.

In addition, the Cabinet must begin recovering the costs of maintaining the buildings and facilities. This may require some changes to how the Cabinet purchases or funds facilities (currently funded through the Road Fund).

c. Collect and analyze building and facility performance measures.

The Cabinet can realize cost savings by improving how they run their facilities. To help, the Finance and Administration Cabinet has published on its website 52 operations and maintenance measures. Implementing them should result in a considerable reduction in energy use. A few of the operations and maintenance measures are listed below:

- Reduce operating hours for lighting systems.
- Lower heating and raise cooling temperature set points.
- Remove scale (calcium buildup) from pipes.
- Insulate ducts.
- Clean boiler surfaces of fouling.

The action steps for implementing operations and performance measures are available at: www.KYTC.state.ky.us/Admin/energy%20plan2.htm.

2. Recommendation XIII-2: Evaluate the business benefits of consolidating the Transportation Cabinet's facility management responsibilities into the Division of Facilities Management in the Finance and Administration Cabinet.

It is important to note that this review did not evaluate this issue. However, the analysis that was conducted indicates that this is an opportunity area that warrants the recommended evaluation. The Division of Property and Supply Services manages facilities and buildings for the Cabinet. The same function is performed by the Division of Facilities Management in the Finance and Administration Cabinet for other state agencies. The purpose of this recommendation is to evaluate the business benefits of combining some of the Cabinet's facility management functions with those in the Finance and Administration Cabinet. The benefits may arise from a concentration of specialized expertise in facility planning and maintenance. A strong argument can probably be made for the Finance and Administration Cabinet to manage some of the Cabinet's specialized facilities, such as maintenance sheds.

Introduction

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This document includes the following Appendices:

- **Appendix A: Description of Projects with Largest Change Order Values**
- **Appendix B: Project Management Information Systems**
- **Appendix C: Accounting and Management Information Systems**

Appendix A: Description of Projects with Largest Change Order Values

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Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
CB06 060 1087 000-001 ARY-VEST ROAD (KY 1087) ARY-VEST ROAD (KY 1087) FROM MP 0.766 EXTENDING EASTERLY TO MP 0.856 ARY-VEST ROAD (KY 1087) FROM MP 0.766	10363	12	5,934	97.9	6,060	-48	4
FE01 040 0027 003-004 LANCASTER-NICHOLASVILLE US 27 THE LANCASTER-NICHOLASVILLE ROAD (US 27) FROM KY 52 (MP 3.034) EXTENDING 250 FEET (MP 3.081) THE LANCASTER-NICHOLASVILLE ROAD (US 27) FROM KY 52 (MP 3.034) FE01 040 0027-003-004	10204	7	163,984	97.7	167,857	-1	6
FD04 019 0027 005-009 SITE PREPARATION FOR PROPOSED MAINTENANCE FACILITY	10583	6	61,472	65.3	94,113	-57	4
CB06 034 1968 002-003 PARKER'S MILL ROAD THE PARKER'S MILL ROAD (KY 1968) FROM 0.695 MILE WEST OF BOWMAN MILL ROAD (MP 2.75) EXTENDING EASTERLY TO MP 2.760	10682	7	31,196	59.8	52,140	7	6
FD04 016 9007 030-031 WILLIAM NATCHER GREEN RIVER WILLIAM NATCHER GREEN RIVER PARKWAY, SLIP AT MP 30.460 SOUTHBOUND WILLIAM NATCHER GREEN RIVER	10727	3	451,867	58.4	773,835	-59	5

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
PARKWAY, SLIP AT MP 30.460 SOUTHBOUND FD04 016 9007-030-031							
FE04 121 DW01 0000031 VARIOUS ROUTES WATERBORNE PAINT STRIPING, WITH QC/QA, ON VARIOUS ROUTES IN ALLEN, BARREN, BUTLER, EDMONSON, LOGAN, METCALFE, MONROE, TODD, AND WARREN WATERBORNE PAINT STRIPING, WITH QC/QA, ON VARIOUS ROUTES IN ALLEN	10823	3	127,223	55.4	229,483	-24	5
FE GR 01 0000009 NEW CIRCLE ROAD (KY 4) SEE FOLLOWING SUB-SECTIONS SEE FOLLOWING SUB-SECTIONS FE02 034 0004-B00038N – (A) NEW CIRCLE ROAD (KY 4) BRIDGE LOCATED OVER N.S. RAILROAD (MP 8.030)	10407	7	157,095	54.4	288,565	-27	3
FE01 056 0841 001-011 JEFFERSON FREEWAY (KY 841) FROM CSX BRIDGE (MP 1.170) EXTENDING EASTERLY TO I-65 (MP 10.250) THE JEFFERSON FREEWAY (KY 841) FROM CSX BRIDGE (MP 1.170) EXTENDING FE01 056 0841-001-010	20400	5	447,938	52.9	846,022	-15	4
FE GR 01 0000005 VARIOUS FE01 120 0060-007-014 – (A) LEXINGTON-VERSAILLES ROAD (US 60) FROM US 60X (MP 7.789) EXTENDING EASTERLY TO THE FAYETTE COUNTY LINE (MP 13.039) A DISTANCE OF 5.241 MILES	10213	7	35,012	51.4	68,134	-68	4
CULVERT REPLACEMENT ON US 119 (MP3.992) FE01	10096	12	298,158	51.1	583,434	-2	1

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
FUNDS							
FD39 017 0091 022.326 PRINCETON-FREDONIA RD (KY 91) THE PRINCETON-FREDONIA ROAD (KY 91) CULVERT REPLACEMENT AT MP 22.326 THE PRINCETON-FREDONIA ROAD (KY 91) FD39 017 0091-022.326	10613	2	68,298	49.7	137,553	-12	3
FD GR 01 0000071 VARIOUS ROUTES FD05 098 0632-000-007 – (A) KIMPER-PHELPS ROAD (KY 632) FROM KY 194 (MP 0.000) EXTENDING TO BLACKBERRY FORK ROAD (MP 6.963) A DISTANCE OF 6.963 MILES	10241	12	2,381,833	46.4	5,138,078	4	1
NH 8716 (1), FD52 056 0841 034-038 SNYDER FREEWAY (KY 841) THE SNYDER FREEWAY (KY 841) FROM I-71 (MP 34.727) EXTENDING TO US 42 (MP 37.006) THE SNYDER FREEWAY (KY 841) FROM I-71 (MP 34.727)	10758	5	494,407	45.9	1,076,000	-38	3
0206 063-8018 VARIOUS LOTS AND DRIVES IN LEVI JACKSON STATE PARK	10216	11	17,000	45.8	37,135	-55	1
IMD 75-1 (61) 11, FD52 118 0075 010-011 LEXINGTON-TENNESSEE RD (I-75) THE LEXINGTON-TENNESSEE STATE LINE ROAD (I-75) RECONSTRUCTION OF THE I-75 SOUTHBOUND EXIT RAMP AT EXIT 11 THE LEXINGTON-TENNESSEE STATE LINE ROAD (I-75)	20709	11	65,606	45.8	143,182	-62	4
THERMOPLASITC PAVEMENT MARKINGS TAYLORSVILLE ROAD KY 155 MP 0-5	20280	5	221,590	45.6	486,166	-38	4
FD05 034 1425 000-001 MAN O' WAR BOULEVARD (KY	20178	7	32,807	44.5	73,800	9	1

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
1425) THE MAN O' WAR BOULEVARD (KY 1425) FROM I-75 RAMPS SOUTH OF THE UNDERPASS (MP 0.000) EXTENDING NORTHERLY TO PAVEMENT CHANGE (MP 0.388)							
FD04 051 9005 013-014 AUDUBON PARKWWAY (AU 9005) THE AUDOBON PARKWAY (AU 9005) EMBANKMENT FAILURE AT MP 13.500 AND 13.970 THE AUDOBON PARKWAY (AU 9005) EMBANKMENT FAILURE AT MP 13.500 AND FD04 051 9005-013-014	10418	2	275,197	43.6	630,795	-26	2
IM 64-7 (43) 154, FD52 022 0064 154-161 LEXINGTON-ASHLAND RD (I-64) THE LEXINGTON-ASHLAND ROAD (I-64) PAVEMENT REHAB FROM SMITH RUN ROSE HILL ROAD (MP 154.220) EXTENDING TO TYGARTS CREEK BRIDGE (MP 160.860) THE LEXINGTON-ASHLAND ROAD (I-64) PAVEMENT	20292	9	5,944,976	43.2	13,746,411	2	1
IM 75-5 (27) 122, FD52 105 0075 122-136 COVINGTON-LEXINGTON-TENNESSEE STATE LINE ROAD (I-75) FROM 1.100 MILES NORTH OF CAVE RUN BRIDGE (MP 122.250) EXTENDING NORTHERLY TO KY 620/ COVINGTON-LEXINGTON-TENNESSEE STATE LINE ROAD	10517	7	1,706,209	42.9	3,974,993	-12	1
FE01 121 DW24 7TH STREET REHABITITATION OF 7TH STREET, BRECKINRIDGE LANE AND RIVER ROAD STORM WATER PUMPING STATIONS REHABITITATION	10503	5	349,192	42.1	829,800	-21	3

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
OF 7TH STREET, BRECKINRIDGE LANE AND RIVER ROAD STORM FE01 121 DW01-0000024							
FD04 059 7110 TURFWAY CONNECTOR ROAD TURFWAY CONNECTOR ROAD (DOLWICK CONNECTOR) FROM 2800 FEET WEST OF ERLANGER-CRESCENT SPRINGS ROAD EAST TO KY 2373 TURFWAY CONNECTOR ROAD (DOLWICK CONNECTOR)	10611	6	161,886	41.8	387,622	-30	3
FD39 098 0194 058-059 PHELPS-FREEBURN ROAD (KY 194) THE PHELPS-FREEBURN ROAD (KY 194) FROM McCOY BOTTOM ROAD (MP 58.028) EXTENDING NORTHERLY TO JOE McCOY ROAD (MP 58.279) THE PHELPS-FREEBURN ROAD (KY 194) FROM MCCOY BOTTOM ROAD (MP 58.028) FD39 098 0194-0	10330	12	231,405	40.6	569,943	4	1
FD04 018 SITEWETLAND CLARKS RIVER FLOODPLAIN CLARKS RIVER FLOODPLAIN WETLAND MITIGATION SITE NEAR MURRAY CLARKS RIVER FLOODPLAIN WETLAND MITIGATION SITE NEAR MURRAY FD04 018 SITE-WETLAND	10738	1	58,410	40.4	144,625	-12	1
FE02 063 0075 B00043 AND B00043P I-75 I-75 OVER THE LAUREL RIVER (MP 30.560) I-75 OVER THE LAUREL RIVER (MP 30.560) FE02 063 0075-B00043N	10101	11	21,280	39.9	53,379	-48	6
FD05 047 1357 014-017 SAINT JOHNS ROAD (KY 1357) SAINT JOHNS ROAD	10335	4	26,981	39.5	68,287	-38	2

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
(KY 1357) FROM KY 3005 (MP 14.614) EXTENDING EASTERLY TO US 31 W BYPASS (MP 16.329) SAINT JOHNS ROAD (KY 1357) FROM KY 3005 (MP 14.614) EXTENDING EASTERLY FD05 047 1357-014-017							
STPS 5274 (6), FD52 063 0229 007-008 BARBOURVILLE-LONDON RD KY 229 REDUCE VERTICAL CURVE AT BARBOURVILLE-LONDON ROAD (KY 229) AND LEFT TURN LANES FOR KY 229 AND RELOCATE KY 1189 REDUCE VERTICAL CURVE	10540	11	101,080	39.1	258,834	-52	2
CB06 056 1819 005-009 BILLTOWN ROAD (KY 1819) BILLTOWN ROAD (KY 1819) FROM I-265 BRIDGE (MP 5.345) EXTENDING NORTHWESTERLY TO MICHAEL ROAD (MP 8.445) BILLTOWN ROAD (KY 1819) FROM I-265 BRIDGE (MP 5.345) EXTENDING CB06 056 1819-005-009	20533	5	85,000	38.6	220,400	-15	2
FD04 054 9004 032-033 E.T. BREATHITT PARKWAY EB 9004 THE E.T. BREATHITT PARKWAY (EB 9004) INTERCHANGE LIGHTING AT US 62 AT NORTONVILLE THE E.T. BREATHITT PARKWAY (EB 9004) INTERCHANGE LIGHTING FD04 054 9004-032-033	20735	2	55,181	37.3	148,108	6	4
0206 021 8013 PARKING LOT, GENERAL BUTLER CONSTRUCT PARKING LOT AT GENERAL BUTLER STATE PARK'S CONVENTION CENTER	20410	6	59,292	36.9	160,847	-11	1
FD04 090 0150 000-001 US	19003	5	250,871	36.3	691,412	98	3

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
150 US 150 IN NELSON COUNTY DESIGN/BUILD PROJECT US 150 IN NELSON COUNTY FD04 090 0150-000-001							
FE01 001 0206 014-015 COLUMBIA-LIBERTY ROAD (KY 206) COLUMBIA-LIBERTY ROAD (KY 206) FROM 1.281 MILE EAST OF THE CASEY COUNTY LINE AT MP 14.403 COLUMBIA-LIBERTY ROAD (KY 206) FROM 1.281 MILE EAST OF THE CASEY FE01 001 0206-014-015	10521	8	17,084	35.9	47,609	-17	3
FE02 097 0080 B00100N HAZARD-HINMAN ROAD (KY 80) THE HAZARD-HINDMAN ROAD (KY 80) BRIDGE LOCATED OVER KY 476 AND TROUBLESOME CREEK (MP 14.849) THE HAZARD-HINDMAN ROAD (KY 80) BRIDGE LOCATED OVER KY 476 AND FE02 097 0080-B00100N	20256	10	27,660	35.5	77,911	-138	9
STPS 5179 (8) FD52 069 0501 002-003 REALIGN ROADWAY (KY 501) THUR KINGS MOUNTAIN TO ELIMINATE TWO 90 DEGREE CURVES	20298	8	111,649	35.4	315,627	-23	8
NH 23-1 (134), FD52 010 0023 013-015 ASHLAND-CATLETTSBURG ROAD ASHLAND-CATLETTSBURG ROAD (US 23) CUT RESTORATION FROM KY 168 TO 0.500 MILE NORTH OF KY 168 ASHLAND-CATLETTSBURG ROAD (US 23) CUT RESTORATION FROM KY 168 TO 0.500 FD52 010 0023-013-015	10755	9	575,633	34.9	1,651,600	-8	8
CB06 054 1069 B00154 THE	20663	2	16,868	34.3	49,158	-12	6

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
OLD MADISONVILLE-HENDERSON ROAD (KY 1069) KY 1069 OVER DEER CREEK. BRIDGE DECK RESTORATION AND WATERPROOFING. THE OLD MADISONVILLE-HENDERSON ROAD (KY 1069) KY 1069 OVER DEER CREEK. CB06 054 1069-B0015							
FE01 008 0275-002-003-(A) CINCINNATI CIRCLE FREEWAY (I-275) 0.078 1 MILE EAST OF THE POINT PLEASANT ROAD OVERPASS WEST BOUND LANE (MP 12.551), A DISTANCE OF 0.000 MILES. FE01 019 0471-000-005-(B) I-275	10579	6	164,514	34.2	481,579	-31	3
FE01 064 0001 000-013 LOUISA-GRAYSON ROAD (KY 1) THE LOUISA-GRAYSON ROAD (KY 1) FROM 0.908 MILE NORTH OF KY 3 (MP 0.908 EXTENDING NORTHERLY TO 0.667 MILE SOUTH OF KY 201 (MP 12.153) THE LOUISA-GRAYSON ROAD (KY 1) FROM 0.908 MILE NORTH OF KY 3	20506	12	13,500	33.7	40,062	22	7
FE02 019 0008 B00003 KY 8 OVER TWELVE MILE CREEK KY 8 OVER TWELVE MILE CREEK. BRIDGE DECK RESTORATION AND WATERPROOFING AND HANDRAIL REPAIR	30187	6	47,545	33.2	143,331	15	4
FE02 009 0068 B00012N PARIS-CARLISLE ROAD (US 68) THE PARIS-CARLISLE ROAD (US 68) BRIDGE LOCATED OVER HINKSTON CREEK (MP 9.405)	10396	7	39,726	32.7	121,628	-5	2

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
FE01 021 0227 004-005 CARROLLTON-WORTHVILLE RD KY227 THE CARROLLTON-WORTHVILLE ROAD (KY 227) AT 900 FEET WEST OF I-71 (MP 4.070) THE CARROLLTON-WORTHVILLE ROAD (KY 227) AT 900 FEET WEST OF I-71 FE01 021 0227-004-005	20638	6	107,210	32.5	330,178	72	1
FD GR02 0000053 KY 20 CONNECTOR (KY 8) AT I-275 EAST BOUND EXIT RAMP (MP 0.910) FE04 008 0008-000-00 – (A) (KY 8) AT I-275 EAST BOUND EXIT RAMP (MP 0.910) THERMOPLASTIC PAVEMENT MARKERS	20118	6	38,170	32.3	118,320	-37	3
FE01 081 0008 004-009 MAYSVILLE-DOVER-AUGUSTA (KY 8) THE MAYSVILLE-DOVER-AUGUSTA ROAD (KY 8) FROM MP 4.800 EXTENDING TO MP 8.900 THE MAYSVILLE-DOVER-AUGUSTA ROAD (KY 8) FROM MP 4.800 EXTENDING TO FE01 081 0008-004-009	10528	9	26,796	32.3	83,049	-19	4
CB GR 03 0000065 VARIOUS ROUTES SEE FOLLOWING SUBSECTIONS SEE FOLLOWING SUBSECTIONS CB06 005 2131-000-004 – (A) THE CORAL HILL HALFWAY ROAD (KY 2131) FROM KY 740 (MP 0.000) EXTENDING EASTERLY TO KY 70 (MP 4.000)	30487	3	200,966	31.5	638,958	6	1
FD51 036 0306 000-003 WHEELWRIGHT ROAD (KY 306) WHEELWRIGHT ROAD (KY 306) FROM BEGINNING OF STATE MAINTENANCE (MP 0.000) EXTENDING	10773	12	82,150	31.0	264,624	-23	2

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
NORTHERLY TO KY 122 (MP 2.800) WHEELWRIGHT ROAD (KY 306) FROM BEGINNING OF STATE MAINTENANCE FD51 036 0306-000-003							
CM-IM 64-2 (154) 8, FD52 056 0064 008-012 LOUISVILLE-LEXINGTON RD (I-64) THE LOUISVILLE-LEXINGTON ROAD (I-64) FROM APPROXIMATELY 600 FEET WEST OF THE COCHRAN HILL TUNNELS EXTENDING EASTERLY PAVEMENT, TUNNEL, AND THE LOUISVILLE-LEXINGTON ROAD (I-64)	10593	5	6,360,706	30.4	20,943,000	15	2
FE01 036 0302 012-013 DEWEY LAKE-PAINTSVILLE KY 302 THE DEWEY LAKE-PAINTSVILLE ROAD (KY 302) REPAIR CULVERT LOCATED 0.245 MILE SOUTH OF THEJOHNSON COUNTY LINE THE DEWEY LAKE-PAINTSVILLE ROAD (KY 302) REPAIR CULVERT LOCATED 0.245 FE01 036 0302-012-013	10514	12	4,500	30.2	14,921	12	4
FE02 059 0177 B00071 KY 177 OVER BANKLICK CREEK KY 177 OVER BANKLICK CREEK. BRIDGE DECK RESTORATION AND WATERPROOFING KY 177 OVER BANKLICK CREEK. BRIDGE DECK RESTORATION AND FE02 059 0177-B00071N – KY 177 OVER BANKLICK CREEK	30217	6	47,346	30.0	157,756	-9	4
FD05 115 0150 004-006 THE SPRINGFIELD-BARDSTOWN ROAD (US 15C) FROM 100 FEET WEST OF CARTWRIGHT CREEK BRIDGE (MP 4.213)	10460	4	379,969	293.5	129,464	8	1

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
EXTENDING EASTERLY TO KY 1724 THE SPRINGFIELD-BARDSTOWN ROAD (US 15C) FROM 100 FEET WEST OF FD05 115 0150-004							
FD05 002 0100-030 HOLLAND-FOUNTAIN RUN ROAD HOLLAND-FOUNTAIN RUN ROAD (KY 100) FROM OMER JOHNSON (MP 27.338) EXTENDING EASTERLY TO THE MONROE COUNTY LINE (MP 29.583) HOLLAND-FOUNTAIN RUN ROAD (KY 100) FROM OMER JOHNSON (MP 27.338) FD05 002 0100-027-030	10615	3	37,133	29.9	124,039	-4	1
FE02 022 0060 B00043N MOREHEAD-OLIVE HILL RD (US 60) THE MOREHEAD-OLIVE HILL ROAD (US 60) BRIDGE LOCATED OVER TYGARTS CREEK (MP 6.241)	10398	9	239,962	197.8	121,322	-13	3
0206 030 8042 BEN HAWES STATE PARK ASPHALT SURFACE AND PIPE REPLACEMENT AT BEN HAWES STATE PARK ASPHALT SURFACE AND PIPE REPLACEMENT AT BEN HAWES STATE PARK 0206 030 8042	20287	2	143,490	151.0	95,051	-4	1
FE01 054 8118 MADISONVILLE HEALTH CAMPUS KENTUCKY COMMINITY AND TECHNICAL COLLEGE SYSTEM AT MADISONVILLE HEALTH FE01 054 8118	10445	2	33,145	127.3	26,030	-54	3
FD04 097 0476 010-011 KY 476 EMBANKMENT FAILURE (KY 476) FROM MP 10.500 EXTENDING TO MP 10.600 EMBANKMENT FAILURE (KY	20309	10	724,758	124.5	581,922	-32	8

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
476) FROM MP 10.500 EXTENDING TO MP 10.600 FD04 097 0476-010-011							
0206 056 8040 E. P. TOM SAWYER STATE PARK PARKING LOT SEALING AND STRIPING AT E. P. SAWYER STATE PARK VRIOUS ROUTES PARKING LOT SEALING AND STRIPING AT E.P. SAWYER STATE PARK VARIOUS 0206 056 8040	20289	5	32,557	120.2	27,088	-75	2
FE02 043 062 B00033N LEITCHFIELD-BEAVER DAM (US 62) DECK RESTORATION AND WATERPROOFING ON BRIDGE OVER P&L RAILROAD DECK RESTORATION AND WATERPROOFING ON BRIDGE OVER P&L RAILROAD FE02 043 0062-B00033N	10144	4	50,676	116.2	43,600	-26	4
FD04 010 0023 000-003 LOUISA-CATTLESBURG RD (US 23) THE LOUISA-CATTLESBURG ROAD (US 23) REHABILITATION FROM THE LAWRENCE COUNTY LINE (MP 0.00) EXTENDING NORTHERLY TO KY 752 (MP 3.024) THE LOUISA-CATTLESBURG ROAD (US 23) REHABILITATION	10180	9	2,787,322	102.3	2,725,385	-9	1
FE01 121 DW02 0000025 VARIOUS FE01 047 DW02-0000025 – (A) MOWING ON VARIOUS ROUTES IN HARDIN COUNTY IN DISTRICT FOUR A DISTANCE OF 92.851 MILES	20146	4	69,418	100.0	69,418	-25	3
FE01 121 DW02 0000055 VARIOUS ROUTES MOWING AND TRIMMING OF	20073	4	25,114	100.0	25,114	-56	6

Project Description	Project No.	District	Change Order Amount ($)	Change Orders Percentage of Award Amount	Award Amount	Engineer's Estimate Difference as Percentage of Award Amount	No. of Bids
VEGETATION AND THE PICKUP AND REMOVAL OF LITTER AND DEBRIS ON ROADWAY EMBAMKMENT DAMS ON VARIOUS ROUTES AND ON I-75							
Total			**$26,793,943**		**$61,534,755**		

Appendix B:
Project Management Information Systems

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This appendix provides additional background on the Kentucky Transportation Cabinet's project management information systems. This appendix is intended as a supplement to the detailed analysis of the Cabinet's project management information and reporting capabilities provided in Section IX.

A. Background

For purposes of this analysis, the Cabinet's key management systems can be divided into the following categories:

- Accounting and Financial Management
- Planning, Programming, and Project Development
- Contract Procurement and Estimating
- Construction Management
- Operations and Maintenance Management

This appendix focuses on systems or applications which specifically capture, track, and report on project information from project identification through project completion. The background provided in this appendix includes applications in the Planning, Programming, and Project Development, Contract Procurement and Estimating, and Construction Management categories. The systems and applications in each of these three categories are described in further detail below.

An assessment of the Cabinet's accounting and other management systems (the systems in the Accounting and Financial Management and Operations and Maintenance Management categories) is contained in Section VIII. Detailed background on these systems is provided in Appendix C.

B. Planning, Programming, and Project Development

This category of applications includes all management systems which support the planning, programming, and preconstruction activities from project conception through planning and design to the point of letting. Each of the major applications in this area is described in further detail below.

1. Six-Year Highway Plan Application

The Six-Year Highway Plan application is an Oracle based application, which manages the creation and publication of the Six-Year Highway Plan. It also provides extensive project tracking and project information for active projects, especially through the preconstruction phase of the project. The preconstruction status reporting function of the Six-Year Highway Plan application includes expenditure to date information for major project categories and comparison of expenditures against encumbrances and budget. The preconstruction status reporting function also includes major milestones and an audit trail of changes to these dates, right of way and utility summary status, and a list of commitments made by the Cabinet staff about the project.

2. Unscheduled Needs List

The Unscheduled Needs List is a Dbase application (with reporting capabilities in Microsoft Access and Excel) maintained in the Division of Planning which contains a list of potential projects not currently scheduled in the Six-Year Highway Plan application. Projects are added to this list as they are identified and initial estimates are developed. This database contains most of the significant potential capital projects which have been scheduled, but it is not a complete inventory of potential projects. Federal corridor initiatives, as well as projects for which selection decisions are primarily made outside of the Division of Planning, such as bridge rehabilitation, pavement rehabilitations, and some safety projects are not included in the Unscheduled Needs List. As of November 2003, the Unscheduled Needs List contains over 2,400 projects, with an estimated cost of $53.5 billion.

3. Gold File

The Gold File is an Oracle based application maintained by the Division of Program Management where the Cabinet keeps track of requests for transportation projects sent to the Secretary of Transportation and the State Highway Engineer to consider for inclusion in the Six-Year Highway Plan. Often, the Cabinet may receive numerous requests for the same project from several elected officials, other organizations, the general public, or Cabinet district staff. In addition, the Cabinet uses the Gold File system to keep track of requests from General Assembly members (House Bill 655 requests) for an estimated project cost by phase and schedule of required time to complete each phase.

The Gold File system provides capability to track the history of project requests, and it also includes data fields to indicate when the Cabinet received the request, and for what Six-Year Highway Plan application the project is to be considered. Project requests are not deleted from this system at any point, but are maintained for historical purposes since projects may be reconsidered at a later date when funding becomes available.

The Division of Program Management is the only Division that enters projects into the Oracle Gold File application and it only adds projects that are sent down from the Secretary's and State Highway Engineer's offices. The project requested for entry in the Gold File is often already identified within the Cabinet's Unscheduled Needs application, but the project is entered into the Gold File system anyway to allow the Cabinet to track the requests channeled through senior management. This application serves as a quick reference for top management, allowing them to quickly review a listing of project requests and even drill down to specified counties, routes, congressional districts, and state senate and state representative districts.

4. LRC Dataset

This is a monthly extract created by the Cabinet and provided to the Legislative Research Commission. It is created from information in the Six-Year Highway Plan application, Project Authorization System, and Contractor Pay Estimate System applications and provides a snapshot of project financial and schedule status for Six-Year Highway Plan application and other Cabinet projects across Design, Right of Way, Utilities, and Construction. Information available in the Legislative Research Commission dataset includes:

- Six-Year Highway Plan application original funding source, budgeted cost, and estimated year for beginning work by category.
- Current funding source, estimated cost, and estimated year for beginning work by category.
- Authorized amount and authorization date by category.

  In addition, for construction contracts, the Legislative Research Commission dataset includes the following information:

  - Letting status and official letting date.
  - Contract award date, contract award amount, and contractor.
  - Number of change orders, date of most recent change order, and net change order amount.
  - Current contract amount and current contract amount earned.
  - Estimated date of project completion.
  - Actual contract completion date (when completed).
  - Current percent complete based on time.

5. Right of Way and Utilities

The Right of Way and Utilities (RWU) system is an Oracle based application which provides detailed tracking of right of way status at the parcel level within a project.

Support for Utilities requirements was originally planned for inclusion in this application, but this functionality has not yet been implemented. There is currently no target date for incorporating the utilities functionality.

C. Contract Procurement and Estimating

Contract procurement and estimating includes all management systems which support the preparation and conduct of the highway construction contract procurement process including preparation of the Cabinet engineer's estimate by the Cost Estimating unit, development of the bid and proposal package, receipt of bids from contractors, the analysis of bids received, and the actual awarding of a contract. Each of the major applications in this area is described in further detail below.

1. PQ Manager

PQManager is a Clarion based mainframe application which manages and tracks prequalification of highway contractors.

2. Win-Bid

Win-Bid is a Clarion based mainframe application that assists with preparation of the Preliminary Specification and Estimating package and is used by Contract Procurement to create and publish proposal bid items.

3. Bid Letting Management System

Bid Letting Management System (BLMS) is a Clarion based mainframe application which supports and assists with management of the bid letting process.

4. HighwayBid

HighwayBid is a Clarion based application which is used to help create the engineer's estimate. It is also used to create a bid file which is returned by contractors on a diskette at the time of bid submission.

5. BidReader

BidReader is a Clarion based application used by the Office of Technology to process contractor bids received through HighwayBid.

6. BidPublisher

BidPublisher is a Clarion based application used by Contract Procurement to publish bids on the internet during and after the letting.

7. BidTabs

BidTabs is a FORTRAN based mainframe application which is used by Contract Procurement to tabulate and analyze bids.

8. BAMS/DSS

BAMS/DSS is the data warehouse and decision support and analysis tool set of the American Association of State Highway Transportation Officials (AASHTO) Trns*port suite. Trns*port BAMS/DSS provides a historical database specifically designed to allow for decision support in the areas of bid monitoring and evaluation, vendor (contractor, subcontractor, and disadvantaged business enterprises) and market analysis, item price estimation, and the planning and budgeting process. We understand many of the analytical capabilities of this decision support tool, although implemented, have not been used.

9. AASHTO Trns*port

A number of the custom developed applications in the Contract Procurement and Estimating area are scheduled to be replaced by modules of the AASHTO Trns*port suite. Trns*port is a suite of software developed by AASHTO through joint development projects funded by its member agencies and supported on an ongoing basis by annual license fees paid by the member agencies who use the software.

The Cabinet is currently in the final stages of testing several Trns*port modules, with implementation of the new modules scheduled for the first quarter of 2004. The Trns*port modules scheduled for implementation:

- **Cost Estimating (CES)**. Trns*port CES provides support for the preparation of parametric, cost-based, and bid-based job cost estimates. Trns*port CES provides a full range of cost estimating capabilities from conceptual estimation to the final engineer's estimate required for award approval.

- **Preliminary Estimating (PES)**. Trns*port PES addresses preletting requirements. With Trns*port PES, the engineer can enter project data, prepare the preliminary specifications and estimate for highway construction projects, combine them into proposals, and select a group of proposals for a bid letting package. Standard reports available within Trns*port PES include the detailed estimate, the proposal estimate, and the proposal. This module has been designed for flexibility in project definition and proposal creation using multiple funding units with the potential for differing participation percentages at both the category and line item levels.
- **Letting and Award (LAS)**. Trns*port LAS provides support for the advertising, letting, and award activities. Trns*port LAS is designed to assist transportation agency staff in advertising proposals, tracking plan and proposal holders, processing bid information, and making award decisions. Trns*port LAS supports development of the notice to contractors and provides support for plan holder management, online and batch data entry facilities for vendor bids, the bid tabulation report, and analyses of the received bids and bid letting summary reports. Additionally Trns*port LAS maintains the vendor file. The Cabinet has also developed a custom extension to the Trns*port LAS module to assist with publication of proposals to the Cabinet web site.

In addition to the modules currently scheduled for implementation, the Cabinet has also licensed the following Trns*port modules:

- **Estimator**. Trns*port Estimator is a PC-based, stand-alone cost estimation system for highway construction for the preparation of detailed estimates. Trns*port Estimator supports generation of cost estimates using cost-based and bid-based techniques.
- **Expedite**. Trns*port Expedite provides for electronic distribution of proposals and receipt of bids. Activities supported by Trns*port Expedite include creation of an electronic proposal by the transportation agency, electronic submission of bid information by the contractor, validation of item quantities by the transportation agency, and electronic verification of the contractor's bid bond. Trns*port Expedite also includes the capability to process and validate bid files created by a contractor outside of Trns*port Expedite prior to the files being imported into Trns*port LAS.

These Trns*port modules, as well as the Trns*port BAMS/DSS module already implemented by the Cabinet, are Oracle-based applications and are tightly integrated with each other through a common database structure shared by all of the modules.

D. Construction Management

Construction Management includes management systems which support project construction, including maintaining the assigned project inspector's daily work reports and other project records, preparation and processing of the contractor's periodic pay estimate, management of change orders, and the tracking of materials testing. Each of the major Cabinet applications in this area is described in further detail below.

1. Contractor Pay Estimate System

The Contractor Pay Estimate System is essentially the sub ledger for construction. The Contractor Pay Estimate System is a Cabinet custom developed application, which consists of both Clarion-based components on the mainframe and DOS components. The Contractor Pay Estimate System is used to process construction contractor pay estimates and manages and tracks construction contract change orders.

2. Kentucky Construction Engineering Program

The Kentucky Construction Engineering Program is the field record keeping system used by construction staff. It tracks daily work activities by construction contractors and is the primary source for information used to create the periodic construction contractor pay estimates. The Kentucky Construction Engineering Program integrates with the Contractor Pay Estimate application for the processing of contractor pay estimates. Like the Contractor Pay Estimate application, the Kentucky Construction Engineering Program is a Cabinet custom developed application.

3. Kentucky Materials Management Information System

The Kentucky Materials Management Information System is an Oracle-based application which tracks many of the testing activities performed by the Materials Lab.

4. AASHTO Trns*port SiteManager

The Contractors Pay Estimate and the Kentucky Construction Engineering Program are scheduled for replacement by the Trns*port SiteManager module of the AASHTO Trns*port suite. The functionality available in Trns*port SiteManager that the Cabinet plans to implement includes:

- Project Inspector Daily Work Reporting.
- Contractor Pay Estimates.
- Change Orders.

Like the other Trns*port modules for the cost estimating and letting and award processes, Trns*port SiteManager is Oracle-based and is tightly integrated with the other Trns*port modules. The Cabinet is currently planning to rollout Trns*port SiteManager in January 2005.

In addition to the functionality described above, Trns*port SiteManager also includes a Materials Management module which provides for identification of the number and type of materials tests required on a particular project and for the tracking of tests completed. Detailed materials test results (actual data values) can be captured for the most frequently performed tests, with pass or fail status recorded for other types of tests. Because tests results are recorded and tied into the project records through the course of the project, use of the Materials Management functionality within Trns*port SiteManager has helped some state transportation agencies to reduce significantly the manual effort required for the materials finalization process at the end of the project to determine if a sufficient number of tests and or certifications from suppliers had been obtained based on the original testing plan for the project.

The Cabinet is currently investigating the feasibility of replacing its custom Kentucky Materials Management Information System application with Trns*port SiteManager. A decision on this initiative is expected in early 2004.

Appendix C: Accounting and Management Information Systems

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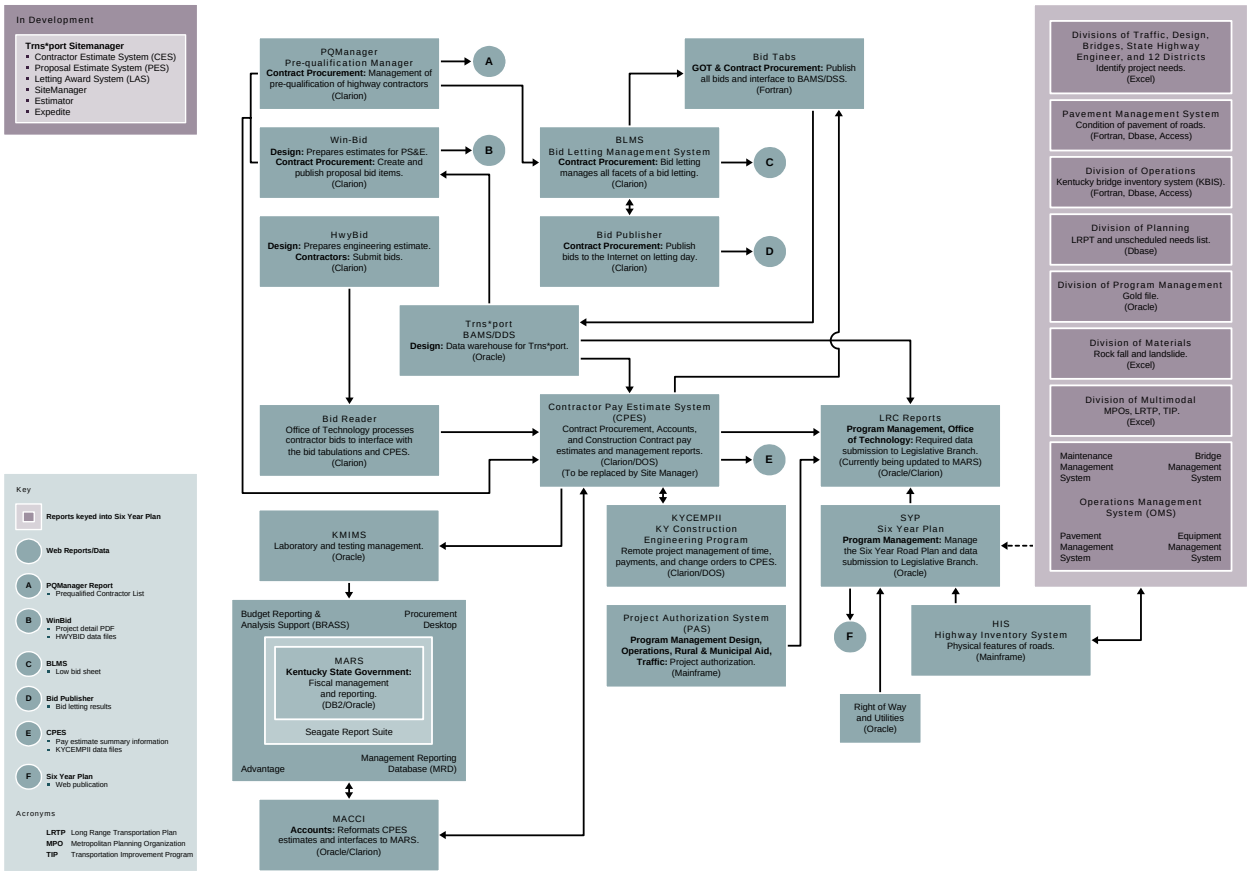
This appendix provides additional background on the Kentucky Transportation Cabinet's accounting and management information systems. This appendix is intended as a supplement to the detailed analysis of the Cabinet's accounting and management information systems provided in Section VIII.

A. Background

The Cabinet is a data and analysis intensive organization. The business of planning, programming, designing, building, maintaining, and operating the highway system is supported by a complex set of related information systems. Exhibit C-1 depicts the Cabinet's application systems architecture or the collection of different information systems that supports its business.

Exhibit C-1: The Kentucky Transportation Cabinet Application Systems Architecture



For purposes of this analysis, the Cabinet's key management systems are divided into the following categories:

- Accounting and Financial Management.
- Planning Programming and Project Development.
- Contract Procurement and Estimating.
- Construction Management.
- Operations and Maintenance Management.

This appendix focuses on providing additional background on systems or applications which fall within the Accounting and Financial Management and the Operations and Maintenance Management categories. An assessment of the Cabinet's systems which provide project information from project identification through project completion, including systems and applications in the Planning, Programming and Project Delivery,

Contract Procurement and Estimating, and Construction Management categories is presented in Section VIII. Additional, detailed background on these project information and reporting systems is provided in Appendix B.

B. Accounting and Financial Management

The Accounting and Financial Management category includes accounting systems and other financial reporting and management tools which support the capturing and analysis of financial information about the operations of the Cabinet. The key components of the Accounting and Financial Management grouping are described below.

1. Management Administrative Reporting System (MARS)

The Management Administrative Reporting System (MARS) is the statewide accounting system used by the Cabinet and other Commonwealth agencies. MARS was implemented statewide in 1999 as an outgrowth of the simplified administrative services goals defined as part of the Empower Kentucky initiative. Prior to implementation of MARS, from 1992 to 1999, the Cabinet utilized STARS, the previous statewide accounting system. Before 1992, however, the Cabinet had its own custom developed internal financial system.

MARS is a package software application provided by American Management Systems (AMS) and includes the following components:

- **Advantage**. Advantage is a mainframe based, DB2 financial management module which captures daily accounting transactions. The primary functions of Advantage utilized by the Cabinet include:
  - General Ledger
  - Fixed Assets
  - Revenue Accounting/Accounts Receivable
  - Encumbrance/Expenditure Accounting
  - Accounts Payable/Cash Disbursements
  - Inventory Control
  - Project Billing/Accounting and Budgeting
  - Cost Accounting/Allocation/Job Allocation
  - Federal Aid and other grants management

- Federal Aid Billing which provides billing data for projects electronically to the Federal Highway Administration's (FHWA) Federal Management Information System (FMIS) module.

- **Procurement Desktop**. Procurement Desktop is an Oracle based procurement system. Features of Procurement Desktop include a Commonwealthwide vendor master file, online requisition review and approval processing, contract preparation, and contract management functionality. Procurement Desktop is utilized by the Cabinet for non-highway construction procurements. The highway construction procurement process is managed by a series of letting and award applications. Once an award has been made to a highway contractor through the letting and award process, a purchase order is then entered into Procurement Desktop.
- **Budget Reporting and Analysis Support**. Budget Reporting and Analysis Support (BRASS) is an Oracle based budgeting tool. BRASS supports budget formulation, review, publishing, and monitoring. It includes what if analysis and modeling capabilities, salary and benefit forecasting, cross tab capabilities, and audit trailing of changes made through the process. BRASS is utilized by the Cabinet throughout the budget process.
- **Management Reporting Database**. The Management Reporting Database is an Oracle based data warehouse which integrates data from Advantage and Procurement Desktop in a common dataset for standardized and adhoc reporting. A number of the Cabinet staff use this application for financial analysis and reporting.
- **SeaGate Report suite**. SeaGate Report suite is a series of predefined custom reports developed using SeaGate Corporation's Crystal Report Writer toolkit. Examples of SeaGate reports include:

  - Monthly budget status reports comparing budget to actual activity by expenditure object category with a computed available balance. Different versions of this report have been produced to summarize the data by Fund/Account, Location, Department, and other data element summarizations. Within a month of fiscal year-end, these reports are run daily so that managers can more closely track budget status.

  - A monthly report which displays all accounting transaction detail for the Cabinet so that users can use the query and filtering tools in Seagate to access data unique to their area of interest. This report provides transaction detail which supports the summarized total on the budget status report described above.

  - A report showing unliquidated encumbrances.

  - A report showing life to date capital and highway project activity and balances.

In addition to the tools available within MARS, the Cabinet has recently linked the Cabinet's Six-Year Plan application (which serves as the Cabinet's principal project management application) with the Management Reporting Database to provide access to actual cost by major category of work (design, right of way, utilities, construction) at the individual project level from within the Six-Year Plan application.

2. Project Authorization System

The Project Authorization System is a Cabinet supported, mainframe based system, which is used to authorize new projects or initiate changes to authorized funding levels for existing projects within the Cabinet. Prior to the implementation of MARS, the Project Authorization System performed a number of the functions now incorporated into the Six-Year Plan application and Project Authorization System was interfaced to STARS, the previous statewide financial system. However, there is currently no interface between the Project Authorization System and MARS. Thus, project authorizations are currently entered manually by Cabinet staff into both the Project Authorization System and then the Project Accounting module within MARS following approval within the Cabinet.

The Project Authorization System is used within the Cabinet to input data for project budget requests, obtain approvals from Cabinet management, and to produce the hard copy project budget request (project authorization) form for signature. These budget requests include both the original funding for a project phase and all modification requests.

MARS tracks the total project budget to date and related life to date activity (encumbrances and expenses) but does not have the capability to track the life history of a project's budget requests. Thus, while each budget request is input into MARS as approved, MARS increments the total project budget to date without retaining the transaction by transaction history of all budget changes, which is maintained for Cabinet analysis within the Project Authorization System application.

3. Cash Forecasting

To manage cash more effectively in the current fiscally constrained environment, the Cabinet has developed a series of spreadsheet models to support cash flow forecasting and analysis. The first of these spreadsheets is used by management in the districts to develop forecasts, at a project level, of projected monthly cash expenditures. The second spreadsheet model, at the Cabinetwide (enterprise level), uses revenue estimates from the "official consensus estimates" for the Road Fund, as well as historical data on expenditures based on a project's stage in the overall life cycle to develop the enterprise information on projected cash inflows and outflows (as a range) for a given period. The expenditure information in this enterprise model is then adjusted as appropriate based on the project specific bottoms-up estimates from the districts.

The projections developed in the districts at the project level are also input into the Six-Year Plan application as updated budget or expenditure estimates, while actual expenditures for each period are provided in the Six-Year Plan application through a link with the Management Reporting Database application. This linkage provides the ability to have updated forecast versus actual expenditures at the project level for any given period.

It should be noted that MARS does provide some day-to-day cash management and treasury management functionality. However, these features are not used by the Cabinet. The Advantage module of MARS provides the capability to track cash activity and available cash balances at cash account levels controlled by the Commonwealth. The cash account level can be as high as the fund level, for example, or as low as an individual account, possibly a federal grant account. Additionally, there are cash controls that can be turned on or off to restrict cash activity to available funds. The Governor's Office of Policy and Management and the Finance Cabinet are the only entities having access to change these cash controls.

C. Operations and Maintenance Management

This category includes management systems which both support the ongoing management of the assets of the transportation infrastructure, as well as aid in selecting potential projects based on analysis of conditions in the existing infrastructure. Systems in this category include Maintenance Management, Equipment Management, Pavement Management, Bridge Management and Safety Management. Each of the Cabinet's major current or planned applications in this area is described in further detail below.

1. Operations Management System

The Operations Management System is an adaptation of an application suite developed by TRDI, a firm based in Austin, Texas focused on developing asset management software for transportation agencies. Developed with a PowerBuilder front end to an Oracle database, it consists of the base components provided by TRDI off-the-shelf plus additional extensions to the applications built by TRDI to meet the specific Cabinet requirements. For the most part, TRDI has incorporated these extensions into the base product and will support the extensions as part of the application suite going forward. In addition, the Cabinet will also be able to take advantage of other extensions developed by TRDI for the North Carolina Department of Transportation, which are also being incorporated as part of the base product.

The Operations Management System consists of the following components:

- **Maintenance Management.** This module was implemented on July 1, 2002 to replace the previous mainframe based maintenance management system. Based on TRDI's Maintenance Manager™ module, the Maintenance Management application captures a record of all maintenance activities performed on

highways maintained by the Cabinet. The Maintenance Management application records what work was done, who did it, what material was used, what equipment was used, how long the work took, and the cost of completing the work. Each maintenance crew has an administrative person who inputs the data into the Maintenance Management application on a daily basis. In addition, the Maintenance Management application has a maintenance rating program associated with it. Twice a year, a number of roadway sections are selected and evaluated in terms of about 25 attributes to generate a rating. The rating data is then used by the Maintenance Management application for predictive analysis and generation of future budget requirements to meet a particular level of service.

- **Equipment Management**. Based on TRDI's Equipment Manager™, the Equipment Management module helps the Cabinet maintain accurate records, forecast equipment life, track maintenance costs, determine wear-out rates, and schedule routine maintenance. The Equipment Management module provides support for tracking equipment inventories, controlling equipment reservations and utilization, managing equipment maintenance activities, tracking parts inventory and turnover, and assigning and tracking equipment depreciation, disposal, and economical replacement. The Equipment Management module is designed to help achieve the highest equipment utilization at the minimum overall cost. The Equipment Management module was also implemented on July 1, 2002.

- **Pavement Management.** Based on TRDI's Pavement Manager™, this module stores, retrieves, and processes user-defined, pavement-related condition and inventory data in order to analyze current conditions, predict future performance, and determine the expected needs of the pavement network. Features of this application include network optimization, network scenario analysis, work program management, pavement performance analysis, and project life cycle cost analysis. The Pavement Management Module is currently being tested in parallel with the existing Cabinet in-house Kentucky Pavement Management system and is scheduled for cut-over to production during 2004.

- **Bridge Management**. Based on TRDI's Bridge Manager™, the Bridge Management module provides the Cabinet with the capability to use bridge condition and inventory data to effectively allocate funds to deteriorating, obsolete, or substandard bridges. The flexible bridge management framework stores, retrieves, and processes bridge condition and inventory data, and allows for analysis of the current condition and needs of the bridge population for a wide range of circumstances. Analysis tools within the system can be used to determine the financial needs for a certain performance level of individual bridges and/or an entire bridge population, predict the future performance levels at various funding levels, assess the backlog in maintenance of the bridge population at various funding levels, and assist in selecting and recommending specific treatments and the timing of projects.

This module is not currently implemented in a production mode. The Cabinet has a goal of implementing this module to provide enhanced bridge management analysis capability over the next three years. The Cabinet entered into a contract with the University of Kentucky Transportation Center in July 2003 to support the Cabinet in this effort.

2. Highway Inventory System

The Highway Inventory System is an Oracle based application maintained by the Division of Planning. It contains an inventory of the physical features of the roadway.

The current Highway Inventory System application was an adaptation of the Oracle Highways software package. Since the Cabinet initially implemented the Highway Inventory System, Oracle Corporation sold this software package to Exor Corporation, which has continued to provide maintenance, enhancements, and support for the product. Currently, the Cabinet is in the process of upgrading the Highway Inventory System to the new release of Exor Highways. The primary benefit of this upgrade will be the tighter integration between the application and the Cabinet's Geographic Information System. Under the new release of Exor Highways, changes can be made in either the Geographic Information System base map or in the Highway Inventory System and reflected in the other component, whereas today updates to roadway inventory or characteristic information must be made in both the Geographic Information System and in the Highway Information System.

3. Kentucky Bridge Inventory System

The Kentucky Bridge Inventory System is an in-house supported mainframe application, which contains information on the structure and conditions of bridges within the Commonwealth. The condition information in the Kentucky Bridge Information System is based on biannual inspections of virtually every structural element of every bridge in the state.

The Kentucky Bridge Inventory System is primarily a repository of bridge condition information. It does not have analytical capabilities to perform "what if" scenarios that can be used to find the optimal set of projects in terms of preserving the bridge infrastructure, ensuring safety, and making the best use of limited resources. The Cabinet performs this type of "what if" analysis manually based on information available in the Kentucky Bridge Inventory System. In the future, the Cabinet plans to perform this type of analysis in the Bridge Management module of the Operations Management System, which would be integrated with the Kentucky Bridge Inventory System to ensure that the analysis performed uses the latest bridge inventory and condition information available.

4. Kentucky Pavement Management System

The Kentucky Pavement Management System is an in-house supported, mainframe FORTRAN application which maintains information on pavement condition and allows for analysis of current condition and prediction of future performance. It is targeted to be replaced by the Pavement Management module of the Operations Management System during 2004.

5. Collision Report Analysis for Safer Highways

The Collision Report Analysis for Safer Highways application, which is maintained by the Kentucky State Police, was developed jointly by the State Police and the Kentucky Transportation Cabinet and implemented in 2000. It contains a repository of collision reports from all law enforcement agencies across Kentucky. The Collision Report Analysis for Safer Highways application itself, however, is only a repository of collision reports and contains no analytical capabilities as such.

6. Safety Management Analysis Tools

Because the Collision Report Analysis for Safer Highways application does not provide analytical capabilities, the Kentucky Transportation Cabinet Office of Traffic Operations has developed several analytical tools to help in identifying and analyzing safety candidate locations. These analysis tools include:

- Use of the ArcView application suite within the Geographic Information System as an analysis tool to overlay collisions and roadway features from the Highway Inventory System. Data is exported from the Collision Report Analysis for Safer Highways application and integrated with other Geographic Information System files to perform more detailed analysis.
- Critical Rate Calculator which integrates collision data, traffic volume data, and the statewide collision rates by roadway classification to allow calculation of collision rates for any length of specific roadway. The Critical Rate Calculator also allows for rate calculation of total collisions, fatal collisions, fatal and injury collisions, runoff the road collisions, and collisions occurring in darkness.
- Crash Rates At Intersections, which identifies crash rates at intersection on the Cabinet maintained system.
- High Crash Location Identifier which allows for roadway section or specific spot analysis and provides options to look at all crashes or just crashes which have been coded as run off the road crashes.
- High Crash Corridor analysis tools to identify highway corridors for additional countermeasures (education, enforcement, and engineering).

- Tools to analyze the impact of lighting (daylight, darkness with lighting, darkness with no lighting, etc.) on crash location.
- Tools to assess effectiveness of various countermeasures employed on a particular roadway section.

7. Accident Manager

Exor's Accident Manager™ has been licensed by the Cabinet for some time. This is an additional module of the Exor Highways suite which could be integrated with the Highway Information System. Accident Manager is intended to provide a repository for collision information and potentially has the flexibility to serve as a common repository for multiple analysis tools as part of an overall Safety Management system framework. Accident Manager has some of the same analysis tools incorporated within it that the Cabinet has developed on its own and with the University of Kentucky Transportation Center.

The Cabinet, however, has had difficulties implementing this application. According to our interviews with Traffic Operations staff, Accident Manager does not function as the Cabinet originally envisioned based on product demonstrations several years ago. In addition, the system is viewed as very cumbersome, especially for the Cabinet's highway district personnel. Also, it has taken several years at this point to get Accident Manager successfully running in the Cabinet's environment with all of the legacy crash data. Consequently, Traffic Operations had to contract with the University of Kentucky Transportation Center to develop essentially the same analysis tools contained within Accident Manager. In addition, the Cabinet staff believes the tools developed for them by the University of Kentucky Transportation Center actually provide greater flexibility. Currently, the Cabinet is able to extract collision data from the Collision Report Analysis for Safer Highways system and import it, through the ArcView tools within the Geographic Information System, and are able to integrate the Collision Report Analysis for Safer Highways data with the Highway Inventory System to perform any number of queries and identifications of safety improvement candidate locations.

There is currently no targeted implementation date for the implementation of the Accident Manager application in production and the Cabinet is considering discontinuing the product license.